Radiation Act 2005

Annual report for the financial year ending 30 June 2022

VICTORIA State Government | Department of Health


Tape Measure
125
kV
mAs
Device Position
Generator
3.57
Dose
0
mm Cu
test, 62
No patient selected
180 cm
150 cm
43.0 cm
Manual
43.0 cm

Radiation Act 2005

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Contents

Radiation regulation in Victoria in 2021–22 – a snapshot

The purpose of the Radiation Act 2005, which took effect in September 2007, is to protect the health and safety of Victorians and the environment from the harmful effects of radiation.

The Act requires that the Secretary of the Department of Health publishes an annual report that describes the activities of the Secretary under the Act and summarises all authorities issued, renewed, suspended, cancelled, varied, transferred or surrendered during that year. The report must also detail all radiation incidents investigated and summarise all prosecutions for offences in that year.

The November 2020 Victorian State Budget allocated more resources to the department in this area. The additional funds enabled the department to increase the number of specialist radiation safety officers in the Radiation Team by 45 per cent (4.5 full time equivalent staff). The five new specialist team members were onboarded by the end of the first quarter of the 2021–22 financial year. This increase has meant that the Radiation Team now has a total of 15 specialist staff, which will increase the capacity to undertake compliance monitoring, assess complex licences and prepare for radiation incidents and emergencies.

At the end of the 2021–22 financial year there were just under 19,000 current licences or approvals issued to organisations or individuals to perform some form of radiation practice or the use of a radiation source.

Over the 2021–22 financial year, a total of 64 individuals notified the department that they were intending to work in Victoria under new laws for automatic mutual recognition of their interstate licence.

The number of licences issued by the department has dramatically increased over the last 15 years. For example, the number of use licences has increased from 6,559 in 2008, to 12,266 in 2014, and to 16,127 at the end of the 2021–22 year. The department's policy has also been to only have one regular decision-maker but the steady and at times rapid increase in application numbers triggered a change in 2022. The department's policy changed with decision-making for use licences being delegated to three team supervisors, both to reduce the workload of the Team Leader, Radiation, and to reduce processing times.

A new duty officer system was established in July 2021 in response to the growing number of licence applications and the impact of the new licensing portal. The duty officer is drawn from within the Radiation Team. The establishment of a roster of subject matter experts in the Radiation Team allows the assessment process to commence as soon as possible and improves processing times.

The department's new radiation licensing portal and database was launched in October 2019. The first stage of implementing the new licensing database focused on the licences and approvals issued to individuals – use licences and approvals for testers and assessors. At the end of 2021–22 financial year, there were 15,992 use licence holders who had registered to use the portal. There are now only approximately 160 licence holders with three year licences that do not expire until the second half of 2022 who have yet to register on the portal.

The portal has resulted in a significant reduction in the average processing times from an average of 18 days to an average of 8 days (with 95% of licences processed within five days) and the numbers of emails that are sent to the department about licensing matters.

Work continues on the next stage of the portal development which will see management licences included.

The department recovered approximately $3.327 million in licensing revenue in the 2021–22 financial year.

The department conducted 170 inspections in the 2021–22 financial year as part of its licensing compliance monitoring program. This was below the Victorian State Budget target of 480 inspections. This shortfall was due to the impact of the pandemic over the reporting period. During the year, the department also conducted 57 virtual audits of radiation practices.

A major work health and safety project that started in the first half of 2021 continued throughout the 2021–22 financial year. One of the main aims of the project was to establish a risk management framework to address the risks associated with the regulatory and emergency functions of the team, such as work outside the office in relation to compliance monitoring, enforcement, incident response and handling of radioactive materials and other hazards.

In October 2021 the department published a compliance and enforcement policy for the process of monitoring a regulated entity's compliance with the Act and enforcing the ban on commercial tanning. Throughout 2021 the department conducted a variety of enforcement actions. One search warrant was obtained and executed in relation to a suspected commercial tanning operation. This resulted in the seizure of five tanning units. Two prosecutions related to the commercial tanning ban were completed during the year, which related to investigations that commenced in previous years.

A use licence issued to a veterinarian was cancelled and a Prohibition Notice was issued to a management licence holder authorised to possess medical imaging units for the purpose of medical radiography. The notice prohibited the licensee to conduct medical radiography for screening purposes where the screening is not part of an approved screening program and without reference to and consideration of clinical indications.

The department completed a self-audit late in the financial year against the IAEA's General Safety Guides 12 (Organization, Management and Staffing of the Regulatory Body for Safety) and 13 (Functions and Processes of the Regulatory Body for Safety) to identify gaps.

During the 2021–22 financial year, 248 radiation incidents were reported to the department compared with 214 in the previous year. Of the 248 incidents, 245 were in the medical sector. Most medical incidents involved unplanned exposure or additional exposure to patients because of errors in patient management or because of equipment error. None of the incidents involved any compromise in security of high consequence sealed sources. The report provides a detailed analysis but concludes that further work is required to obtain suitable details for all radiation incidents and to evaluate those incidents based on factors such as underlying causes, licence holder type, equipment type/manufacturer, etc. This will allow a better understanding of the range and frequency of the proximate and ultimate (root) causes of radiation incidents with the aim of identifying areas that the department can focus on to reduce the frequency of these incidents in the future. This will be a focus in the 2022–23 financial year.

Introduction

Diagnostic, therapeutic, industrial and other uses of radiation have contributed to the safety and quality of life for all Victorians. However, radiation does involve hazards if it is used inappropriately or unnecessarily. For this reason, the department regulates the use of radiation to protect people and the environment from its harmful effects by licensing users of radiation sources and managers of radiation practices under the Act.

Section 134 of the Act requires that the Secretary of the Department of Health, in respect of each financial year, publish a report that:

a. describes the activities of the Secretary under the Act
b. includes a summary of all authorities issued, renewed, suspended, cancelled, varied, transferred or surrendered during that year
c. includes all radiation incidents investigated in that year
d. includes a summary of all prosecutions for offences against the Act or the Regulations commenced in that year
e. includes any other prescribed matter.

This 2021–22 annual report describes the activities of the Secretary for the financial year from 1 July 2021 to 30 June 2022.

Legislation

Radiation Act

The *Radiation Act 2005* (the Act) commenced operation on 1 September 2007. The Act repealed previous laws.

The Act gives effect to Victoria's commitment to the National Directory for Radiation Protection (NDRP) published by the Australian Radiation Protection and Nuclear Safety Agency. The NDRP outlines a common approach for Commonwealth, state and territory governments in regulating radiation practices.

The purpose of the Act is 'to protect the health and safety of persons and the environment from the harmful effects of radiation' and incorporates:

- the radiation protection principle
- a requirement for the Secretary of the department to have regard to both the radiation protection principle and the National Directory for Radiation Protection
- the concept of licensed activities; in particular, the licensing framework created by the Act features:
  - management licences that authorise the conduct of radiation practices (such as possessing a radiation source)
  - use licences that authorise a natural person to use a radiation source
  - radiation facility construction licences
- the concept of approved testers and the testing of prescribed radiation sources against declared radiation safety standards
- the concept of approved assessors of security and transport security plans.

The Act creates significant offences including:

- conducting a radiation practice without a management licence (the maximum penalty in the 2021–22 period for a body corporate for this offence was $1,635,660)
- using a radiation source without a use licence (the maximum penalty in the 2021–22 period for an individual for this offence was $218,088)
- noncompliance with the conditions of a management licence (the maximum penalty in the 2021–22 period for a body corporate for this offence was $1,090 440).

Radiation Regulations

The Radiation Regulations 2017 prescribe:

- licensing fees
- definitions of radioactive material
- radiation dose limits
- those radiation sources that must be tested and issued with a certificate of compliance before use and at specified intervals afterwards.

The Regulations also:

- strengthen the security of high-consequence radioactive material
- implement changes to the occupational dose limit to the lens of the eye to reflect recent international and national developments.

How is the Act administered?

The Radiation Team

Most of the significant powers and functions of the Act rest with the Secretary to the Department of Health. However, in practice most of the powers needed to administer the laws are delegated to the staff of the department.

The Act is administered by a specialist team known as the Radiation Team.

The November 2020 Victorian State Budget allocated more resources to the department in this area. The additional funds enabled the department to increase the number of specialist radiation safety officers in the Radiation Team by 45 per cent (4.5 full time equivalent staff). The five new specialist team members were onboarded at the end of the first quarter in the 2021–22 financial year. This increase has meant that the Radiation Team now has a total of 15 specialist staff. However, as discussed later, the ongoing pandemic has meant that the impact of the increase in staff in relation to the increased compliance monitoring capacity has not been fully realised due to periods where onsite monitoring inspections were curtailed.

The Radiation Team (team) is located within the Environmental Health Regulation and Compliance Unit (unit), which also administers two other state-wide regulatory systems. The unit has two support teams which provide support to the Radiation Team:

- An Operational Support Team which provides services such as telephone and email response, website management, investigations and management of the unit's risk management system.
- An Information Systems Team which, amongst other things, administers the software systems that the team depends upon to administer the licensing system.

The unit is located within the department's Public Health Division.

The team is led by a Team Leader and structured into three specialist teams. These teams are led by Team Supervisors who report directly to the Team Leader. The three specialist teams are the:

- Medical and Veterinary Radiation Practices Team which has five full-time staff.
- Dental and Non-ionising Radiation Practices Team which has 2.5 equivalent full-time staff.
- Industrial Radiation Practices Team which has three full time staff.

There are also three other staff who report to the Team Leader:

- Expert Adviser, Radiation Safety
- Senior Radiation Safety Officer
- Senior Project Officer.

The Radiation Team has two core responsibilities which are:

- the regulation of radiation practices and individuals authorised to use radiation sources to protect worker health, public health, and the environment from the harmful effects of radiation; and
- preparing for and responding to radiation incidents.

The Licensing System

The Act contains a licensing framework combined with a series of significant offence provisions. The licensing framework involves:

- 'Facility construction' licences which authorise construction of a 'radiation facility'; currently limited to premises where it is intended to store high consequence radioactive material (material with security requirements mandated, in addition to radiation safety requirements).
- 'Management licences' which authorise the conduct of a radiation practice. Radiation practices include:
  - Possession of radiation sources (such as X-ray units; CT scanners; radiopharmaceuticals as used in nuclear medicine; radioactive sources used in industrial practices such as radiography of pipes or welds)
  - Transport of radioactive material
  - Sale of radiation sources
  - Research involving the exposure of persons to ionising radiation
  - Disposal of radiation sources
  - Mining or processing of radioactive material (in Victoria's case – mineral sands)
- 'Use licences' which authorise individuals to use a radiation source
- 'Approved testers' which authorise individuals to issue certificates indicating compliance with mandatory radiation safety standards for certain types of medical diagnostic X-ray units
- 'Approved assessors' which authorise individuals to issue certificates indicating compliance with mandatory security standards for high consequence radioactive material

It is worth noting that the drafting instructions for the original Act were to provide a wide power to make conditions but to not define technical matters in the Act or Regulations that were likely to need frequent change to reflect international and national agreements. This omission of technical matters in the Act and Regulations necessitated a wide-ranging power to make and apply enforceable conditions of licence.

All licences issued by the department are subject to conditions. These conditions are increasingly focused on compliance with nationally agreed Codes specific to their type of practice.

Radiation safety incidents are also required to be reported to the department. The overwhelming majority of these incidents occur in medical practices but have also occurred in industrial practices. Some types of incidents such as transport accidents involving radioactive material, or the loss or theft of radioactive material require an urgent response. These incidents are discussed in more detail later in this report.

Automatic mutual recognition

In late 2020, National Cabinet agreed to implement automatic mutual recognition (AMR). AMR allows a person who is licensed or registered for an occupation in one jurisdiction to be considered licensed or registered to perform the same activities in another jurisdiction, without the need to go through further application processes or pay additional fees. This makes it easier for workers who need to be licensed or registered for their job to work in another state and territory.

AMR for occupational licences became available from 1 July 2021 in certain states and territories. Victoria entered the scheme on this date with the scheme applying to the following types of authorities:

- Use licences
- Approved testers
- Approved assessors.

An interim declaration was made on 1 July 2021 by the Victorian Treasurer that required any worker coming into Victoria to work under these arrangements to have first notified the department providing specific information.

Any worker wishing to work in Victoria under these arrangements must notify the department using a smart form available on the department's website before starting work. The department will publish an interim public register of the workers that have notified the department during the 2022–23 year, with the consent of those workers.

In January 2022 the Victorian Acting Minister for Health extended the mandatory notification requirement of intention to work in Victoria until at least 2032.

During the 2021–22 financial year the department continued to liaise with other jurisdictions on the implementation of the system.

Over the 2021–22 financial year, a total of 64 individuals notified the department that they were intending to work in Victoria under these arrangements. These numbers are expected gradually to increase over the next financial year as more workers in other jurisdictions become eligible to work in Victoria and more workers become aware of the system.

AMR is now in place in all states and territories except Queensland, but some jurisdictions have allowed more time to prepare for specific licensing schemes including radiation safety. The differences between jurisdictions approaches and implementation timing have continued to make the implementation of AMR complex.

The challenges for the department going forward with this new system will include:

- building the notification system directly into the licensing portal (discussed later in this report)
- responding to enquiries from other jurisdictions about workers being allowed to work in Victoria under these arrangements in a way that both meets their needs and is efficient in a resource constrained environment. For this reason, the department will explore the potential for expanding the public register that it publishes to include more details to reduce the need for these enquiries and to be more transparent about this aspect of the licensing system.

Summary of authorities issued by the department

Section 12 of the Act creates an offence for a person to conduct a radiation practice unless the person holds a management licence or is exempted under section 16 of the Act.

The most common radiation practice requiring a management licence is possessing a radiation source. Other radiation practices include:

- transporting radioactive material
- selling radiation sources
- procuring or arranging research that involves exposing people to radiation
- mining or processing radioactive material.

Section 13 of the Act creates an offence for a person to use a radiation source unless the person holds a use licence or is exempted under section 16 of the Act.

The numbers of authorities issued, renewed, suspended, cancelled, varied, transferred and surrendered under the Act during 2021–22 are listed in Table 1.

Table 1: Number of authorities issued, renewed, suspended, cancelled, varied, transferred and surrendered under the Radiation Act, 1 July 2021 to 30 June 2022

Authority	Management licence	Use licence	Tester	Assessor
Issued	126	2,641	18	0
Renewed	1,717	5,249	15	0
Suspended	0	0	0	0
Cancelled	0	1	0	0
Varied	597	384	3	n/a
Transferred	46	n/a	n/a	n/a
Surrendered	67	7	0	0

The numbers of current authorities under the Act as of 30 June 2022 are listed in Table 2.

Table 2: Number of authorities issued as of 30 June 2022

Authority	Number
Use licences	16,127
Management licences	2,786
Approved testers	43
Approved assessors	8

The estimate of the sectors in which these licences are held is listed in Table 3.

Table 3: Estimate of the sectors in which licences are held under the Radiation Act, 1 July 2021 to 30 June 2022

Sector	Management licence	Use licence
Dental	1,491 (47.80%)	5,308 (32.68%)
Veterinary	390 (12.50%)	2,446 (15.06%)
Medical	224 (7.18%)	6,300 (38.79%)
Industrial	242 (7.76%)	1,522 (9.37%)
Sales	164 (5.26%)	n/a
Chiropractic	61 (1.96%)	165 (1.02%)
Transport	46 (1.47%)	n/a
Education	35 (1.12%)	84 (0.52%)
Mining	3 (0.10%)	n/a
Other	463 (14.84%)	415 (2.56%)

Licensing portal and database

The department's new radiation licensing portal and database was launched in October 2019.

The first stage of implementing the new licensing database focused on the licences and approvals issued to individuals – use licences and approvals for testers and assessors. At the end of 2021–22 financial year, there were 15,992 use licence holders who had registered to use the portal. There are now only approximately 160 licence holders with three year licences that do not expire until the second half of 2022 who have yet to register on the portal.

The new system features a contemporary model where users first register their contact details on a web portal. New applicants can then apply for licences or approvals. Based on the type of licence that the person wishes to apply for, the system advises the applicant of the documents that must be supplied with the application. The new system removes the need for data entry by the department, which allows the application to be assessed more quickly than in the past. Similarly, where a fee must be paid for an individual licence, this fee payment occurs when the application is lodged, which eliminates one of the processing delays in the current system.

Users can:

- download a copy of their licence
- apply for variations to an existing licence or approval
- renew their licence at the appropriate time
- make credit card payments
- update their contact details.

Another feature of the new system is that it accommodates those workers who wish to apply for a licence under the mutual recognition laws that operate across Australia. This recognition of a licence issued in another jurisdiction for the purpose of issuing a licence in Victoria is different to a person working in Victoria under Automatic Mutual Recognition. The licensing system allows the person easily to apply under these arrangements. A process to notify the department of a worker's intention to work in Victoria under Automatic Mutual Recognition will eventually be built into the portal.

The system also features an improved public register of licences <https://licensing.dhhs.vic.gov.au/public/use-licence>.

The portal has resulted in a significant reduction in the average processing times from an average of 18 days to an average of 8 days (with 95% of licences processed within five days) and the numbers of emails that are sent to the department about licensing matters. However, there has been a need to support users in resolving technical issues with their use of the system.

During the 2021–22-year, work continued on the development of the system to incorporate the more complex management licences, usually held by companies and other organisations. These are the licences that authorise possession of radiation sources as well as many other practices. There are over 2,700 management licences.

The management licence module, like the system used for individual licences, is based on a set of business rules that the system uses to advise users of the documents that they will need to upload with their application. Initially, the department will not require fees to be paid at the time the application is lodged but will invoice the applicant through the portal before the application is decided. The department will monitor the use and performance of the system and expects to transition to the 'upfront' payment of fees at a later date.

Another new feature of the system is aimed at the applicants and licence holders who seek to possess radiation sources. The system will ask the user to identify the make(s) and model(s) of the radiation source(s) they wish to acquire. Business rules are then used to complete the application, saving time for the applicant and improving data quality.

The new system is expected to be implemented at the end of the third quarter of 2022. This will enable the retirement of the legacy database that has been used for over 16 years.

The entire system is also being migrated to a new cloud environment. With this change, access to the licensing portal will change from the DHHS website <https://licensing.dhhs.vic.gov.au> to the Department of Health website. The change also enables improved integration with other departmental systems including Azure Active Directory authentication and Power BI reporting for Radiation Team staff. The migration is expected to be completed in late 2022. All licence holders and authorised contacts will be advised via email when the new system is live.

Delegations

The number of licences issued by the department has dramatically increased over the last 15 years. For example, the number of use licences has increased from 6,559 in 2008, to 12,266 in 2014, and to 16,127 at the end of the 2021–22 financial year. This increase has resulted in a corresponding growth in the processing and assessment workload. The new licensing portal has eliminated data entry by departmental staff and improved the quality of applications. The decision of whether or not to grant a licence based on a licence application must be made by a delegate of the Secretary.

The department's approach has been, as far as possible, to delegate decision-making for licensing matters to the level that is best placed to make the decision (normally the Team Leader, Radiation) whilst also providing for upward redundancy if the normal decision maker is unavailable.

The policy has also been to only have one regular decision-maker but the steady and at times rapid increase in application numbers triggered a change in 2022. The decision-making for use licences has been delegated to the three team supervisors, both to reduce the workload of the Team Leader, Radiation, and to reduce processing times.

Duty officers

A new duty officer system was established in July 2021 in response to the growing number of licence applications and the impact of the new licensing portal. The duty officer is drawn from within the Radiation Team. Previously, all applications were triaged by a small team of operational support officers to check for completeness and consistency with business rules. This team then performed the necessary data entry and filing of the applications before forwarding them onto a subject matter expert in the Radiation Team for an assessment of merit. The licensing portal now performs most of those triage functions and eliminates the need for data entry. The establishment of a roster of subject matter experts in the Radiation Team allows the assessment process to commence as soon as possible and improves processing times.

Revenue

The department recovered approximately $3.327 million in licensing revenue in the 2021–22 financial year.

Fee policy

The Victorian Guide to Regulation and general government policy is that regulatory fees and user charges should be set on a full cost recovery basis because it ensures that both efficiency and equity objectives are met.

The department's approach is therefore to aim to recover the full cost of the administration of the Act. This is done by setting fees based on the following principles:

- Applications for use licences attract a fee consisting of a non-refundable application fee plus a licence fee based on the time period of the licence, i.e., the longer the licence, the higher the fee but there is a small discount for longer licence periods to reflect the slight reduction of administrative burden associated with longer period licences.
- The fee for a use licence does not depend on the type of radiation source proposed to be used.
- Applications for a management licence attract a fee based on a non-refundable application fee plus a licence fee based on a combination of factors:
  - The types and numbers of radiation sources to be possessed. Sources deemed to represent a higher risk to workers, patients, or the environment attract a higher fee compared to sources considered to be of lower risk
  - The time period of the licence – the longer the period, the higher the fee.
- There is currently no fee for a facility construction licence because the legacy licensing database cannot process a fee for this type of licence type at this time. When the database can process such fees, the department will seek to amend the regulations to require payment of a fee for this licence type.
- Applications for an approved assessors' authorisation do not currently attract a fee. This absence of a fee reflects the department's policy of removing disincentives to work in this area.

The cost of the radiation safety regulatory programme was reviewed in mid-2022 and compared to the fees recovered in the 2021–22 year. This review found that the fees are still set at levels that achieve full cost recovery.

Fees for 2021–22

Licensing fees are defined by the Radiation Regulations in terms of the numbers of fee units that relate to the application or licence. The value of a fee unit is set by the Victorian Treasurer by a direction made under section 6 of the *Monetary Units Act 2004*. The direction is published in the Victorian Government Gazette.

For the 2021–22 financial year the value of a fee unit was $15.03.

The licensing fees for each year are published on the department's website <www.health.vic.gov.au/radiation/a-list-of-the-prescribed-fees-for-radiation-licences>.

Compliance and enforcement policy

In October 2021, the department published a compliance and enforcement policy for the process of monitoring a regulated entity's compliance with the Act and enforcing the ban on commercial tanning. The policy is available on the department's website <www.health.vic.gov.au/publications/compliance-and-enforcement-policy>.

Enforcement action

Providing advice and education to duty holders will always be the first step in seeking compliance with the Act and the Regulations. However, there may be some instances in which enforcement action is required.

The Act provides the department with several enforcement tools in addition to the power to prosecute.

Available enforcement actions

Improvement notices

The Secretary, or a delegate of the Secretary, may issue this type of notice if they believe that a person has contravened a provision of the Act or the Regulations in circumstances that make it likely that the contravention is continuing or will reoccur, or is likely to contravene a provision of the Act or the Regulations. If issued, the notice will require the person to remedy the contravention or likely contravention or the matters or activities causing the contravention or likely contravention.

Prohibition notices

Like improvement notices, these notices may be issued by the Secretary or a delegate under the same circumstances. The notice prohibits the person from carrying on the activity, or the carrying on of the activity in a specified way, until the Secretary or the delegate has certified in writing that the contravention has ceased or that the likelihood of the contravention occurring has passed.

Show cause notice

The Secretary or a delegate may issue a show cause notice notifying a licence holder of an action the Secretary or a delegate proposes taking in relation to a contravention of a requirement of the Act, with an invitation to the holder to show cause why the proposed action should not be taken.

Executing a search warrant

While the Act provides power for authorised officers to enter certain places to monitor compliance with the Act or the Regulations, under some circumstances it is necessary first to obtain a search warrant to authorise that access. An authorised officer of the department may apply to a magistrate to issue a search warrant if the authorised officer believes on reasonable grounds that there is, or may be within the next 72 hours, a particular thing (including a document) at the place that may afford evidence of an offence against the Act or the Regulations.

Forensic data analysis

During the 2021–22 financial year, the department engaged a forensic IT consultant to provide forensic analysis of devices such as mobile telephones and computers as part of the investigation process that occurs during the execution of a search warrant.

Seizure of articles

The Act gives certain powers to authorised officers, including the power to seize anything (including a radiation source or a document) if the authorised officer reasonably believes:

- the seized thing is connected with an alleged contravention of the Act or the Regulations, or
- there is a serious risk to the health or safety of any person or the safety of the environment if the thing is not seized.

Making a radiation source inoperative

The Act gives an authorised officer power to make a radiation source inoperative.

Sealing a radiation source

The Act gives an authorised officer the power to seal a radiation source. In practice, sealing a radiation source may be required where it is impractical to seize the source, but it is necessary to prevent its further use.

Suspending or cancelling an authority

The Act provides that the Secretary, or a delegate, may suspend or cancel an authority.

Prosecution

There are several significant offences contained within the Act and, under certain circumstances, the department may feel it is necessary to begin prosecutions for these offences.

Enforcement actions taken in 2021–22

Table 4 summarises the formal enforcement actions the department took during the year. In general, the lockdowns have affected the numbers of compliance-related inspections, which has affected the number of enforcement actions.

One search warrant was obtained and executed in relation to a suspected commercial tanning operation. This resulted in the seizure of five tanning units.

Two prosecutions related to commercial tanning ban were completed during the year, which related to investigations that commenced in previous years. These are discussed later in the report.

A use licence issued to a veterinarian was cancelled (see focus on veterinary radiation practices section below).

A Prohibition Notice was issued to a management licence holder authorised to possess medical imaging units for the purpose of medical radiography. The notice prohibited the licensee to conduct medical radiography for screening purposes where the screening is not part of an approved screening program and without reference to and consideration of clinical indications. The notice was issued on the grounds of a contravention of the *Code of Practice for Radiation Protection in the Medical Applications of Ionizing Radiation (2008)* which was identified during a compliance inspection.

Table 4: Enforcement action

Enforcement action	Number
Improvement notice	0
Prohibition notices	1
Show cause notice	0
Execution of a search warrant	1
Sealing a radiation source	0
Seizure of commercial tanning units	5
Prosecutions initiated	3
Licences suspended	0

Training

The members of the Radiation Team were provided with a diverse range of training during the year, which included:

- Department and team induction for all new staff members.
- A defensive driver course was completed by almost all authorised officers to ensure that the risks of driving associated with compliance monitoring inspection work are minimised.
- Sexual harassment awareness training. This training was compulsory for all departmental staff.
- A Certificate IV in Government Investigations course was completed by all new staff members.
- Authorised officers underwent fit testing of N95 masks that were to be worn when required to minimise the spread of coronavirus during compliance monitoring inspection work particularly in sensitive settings such as hospitals.
- Almost all authorised officers underwent conflict resolution and de-escalation training. The aims of the training were to minimise the risks associated with managing difficult persons and develop the competence of authorised officers in conflict management, de-escalation and risk minimisation.
- Infection prevention control training to minimise the risk of coronavirus infections.
- Training on the Code of Conduct for Victorian Public Sector Employees. The code of conduct reinforces the Victorian public sector values by describing the expected standards of behaviour.

Staff development

The department has a study assistance policy and during the year assistance was provided to two staff members to undertake specialist post-graduate university education.

One staff member obtained a Master of Medical Physics from RMIT University during the year.

Another staff member continued working towards a Master of Radiation Health Physics degree, being delivered remotely by the University of Oregon.

Work health and safety

A major work health and safety project that started in the first half of 2021 continued throughout the 2021–22 financial year. One of the main aims of the project was to establish a risk management framework to address the risks associated with the regulatory and emergency functions of the team, such as work outside the office in relation to compliance monitoring, enforcement, incident response, and handling of radioactive materials, and other hazards.

By the end of the financial year, risk assessments had been completed, safe work procedures had been developed and most standard operating procedures that reflected the safe work procedures had been developed. A dynamic risk assessment tool was also developed to ensure that unforeseen risks are also recognised in the field.

This project has already led to a range of specific training initiatives, discussed elsewhere in the report, including a defensive driving course, in recognition of the distances that team members travel when on compliance monitoring or stakeholder liaison work across Victoria. A highly focussed workshop on conflict resolution was also held, in recognition of the fact that the role of regulators can sometimes lead to an escalation in tensions when enforcement action is being taken.

Remote work

One of the risks that inevitably occurs with regulatory staff is the risk associated with visiting a regulated entity premises where there is the potential for aggressive behaviour directed towards staff. The department considers the likelihood extremely low, but it is never zero for any regulator. Whilst the department sometimes conducts inspections with two or more staff members, this is not always possible, unless specific risks have been identified. The other common risk for regulators is that there are often large distances to travel for staff whose regulatory activities encompass the entire state. It is common for staff members to conduct a number of inspections in regional areas over a number of days. This usually involves extensive travel to several sites during the day and then back to a motel at the end of the day.

For the above reasons, the department has trialled the use of specialist software known as 'SHEQSY' which provides real-time tracking of staff performing compliance monitoring or stakeholder liaison activities away from the office. It also provides a panic alert system that the worker can use to notify their supervisor of an urgent problem. It also provides a useful tracking of the times that staff members expect to leave regulated entities' premises or return to the motel at the end of the day and notifies staff supervisors where appropriate. The trial concluded late in the financial year and the software is now being rolled out to all regulatory staff.

Radiation dose monitoring

The act of regulation of ionising radiation means that team staff regularly enter sites where radioactive material is possessed, stored or used, and areas where X-ray units are regularly being used.

Staff members are provided with real-time personal dosimeters, which are set to alarm if a pre determined dose or dose rate is exceeded. This dosimeter setting provides an 'early warning' system for high dose situations to which staff members may need to respond.

In addition, all staff members who may be exposed to ionising radiation in the course of their work are provided with radiation dose monitoring badges that measure the cumulative dose received by staff members over a three-month monitoring period.

The department uses the commercial services of a personal radiation monitoring service (PRMS) provider, which supplies monitoring badges that measure doses from fast neutrons, beta rays, and gamma rays.

The doses recorded by these badges are provided to the Australian Radiation Dose Monitoring Register administered by ARPANSA. This ensures that a lifetime record is kept of the ionising radiation doses received by our staff.

The department receives reports of the doses recorded on these badges every three months. The dosimeters are swapped over every three months and the badge that has been worn is sent to the service provider for processing in their laboratory. The downside of this type of dosimeter is that the radiation dose received on a daily basis is not known. Similarly, the dose accumulated over the wearing period is not known until it has been processed and reported by the laboratory.

A trial commenced late in the financial year of a different type of monitoring device – an instant dose personal dosimeter. The device wirelessly captures, transmits, measures, analyses, and reports radiation dose as often as needed. It offers the advantage of a daily recording of the radiation doses received by the wearer. The trial will continue for 12 months.

Stakeholder engagement and communication activities

Informed stakeholders are more likely to work in partnership with the department. They are more aware of the laws that govern them, the potential risks associated with their practices, and ways to mitigate those risks. Informing and engaging with stakeholders is critical to the overall regulatory objective and allows for collaboration and education to achieve regulatory objectives.

The department has been making a significant effort to increase email communication with regulated entities to distribute information. As a result of the need for the department's staff, like other Victorians, to work from home where possible from the last quarter of the financial year, the department accelerated this effort and is now distributing all written communications by email. Implementing the new licensing system (discussed earlier) has greatly assisted in this effort, as has the redeveloped website <https://www.health.vic.gov.au/public-health/radiation>.

Newsletters

Three editions of the radiation newsletter 'The Source' were published by the Radiation Team and distributed to approximately 20,461 stakeholders.

The Source, August 2021, advised management licence holders of the implementation of the *Code for Radiation Protection in Planned Exposure Situations,* and the requirement to submit Radiation Management Plans, provided information on the Australian Government's scheme for Automatic Mutual Recognition, presented three new standard components for radiation oncology developed as part of the Australian Health Facility Guidelines, and provided an update from the Australian Radioactive Waste Agency tasked to manage our nation's radioactive waste.

The Source, October 2021, informed stakeholders about the release for comment of the draft National Strategy for Radiation Safety and Implementation Plan and the publishing of the Compliance and Enforcement Policy used by the department to guide its work in the regulation of radiation sources and their use.

The Source, July 2022 communicated the upcoming launch of the new licensing portal for radiation management licences, upcoming variations to licences in line with new national codes, and the updated requirements for the discharge of radioactive material to sewer. This edition also reported on compliance inspection activities for radiation management licence holders in the medical, dental, research, transport, and mining sector.

External presentations

The department carried out two presentations on radiation incident response to Fire Rescue Victoria and one on radiation safety and the Act and the Regulations to dentists and dental therapists at the Melbourne Dental School.

National context

International peer-review of Australia's regulation of radiation safety

The International Atomic Energy Agency (IAEA) Integrated Regulatory Review Service (IRRS) mission visited Australia from 5 to 16 November 2018. The IRRS reviewed the legal and governmental framework of Australian states and territories and the commonwealth for nuclear and radiation safety against the IAEA's safety standards.

The IRRS report on the mission <https://www.arpansa.gov.au/sites/default/files/irrs_australia_report_2018.pdf> has been published on ARPANSA's website.

The IRRS report made four notes of good practice, 23 recommendations and 12 suggestions for improvement. The recommendations centred on issues of national uniformity, emphasising the importance of ensuring a consistent level of protection of people and the environment through effective coordination and harmonised implementation of codes and guides by the commonwealth, states, territories and regulatory bodies.

The Environmental Health Standing Committee (known as 'enHealth') of the Australian Health Protection Principal Committee led development of an IRRS action plan <https://www.arpansa.gov.au/sites/default/files/irrs_action_plan.pdf> to address the IRRS recommendations. The enHealth's Radiation Health Expert Reference Panel provides assistance to enHealth in this work.

Australian jurisdictions are expected to have substantially addressed the observations, recommendations and suggestions in the IRRS mission report by the time of the follow-up IRRS mission, which is scheduled to take place between 16th and 27th October 2023.

Self-audit

Recommendation R5 of the IRRS report stated that '... Governments should ensure that all parties having responsibilities for safety of facilities and regulatory activities have the necessary competence and resources to carry out their responsibilities.'

The action plan discussed earlier required that state and territory regulators undertake a self-audit against the IAEA's General Safety Guides 12 (Organization, Management and Staffing of the Regulatory Body for Safety) and 13 (Functions and Processes of the Regulatory Body for Safety) to identify gaps. This would inform decisions about competencies and resources. The department completed the self-audit late in the financial year. It was presented to the ministerial Radiation Advisory Committee (discussed later in this report). The audit showed that the department was on the 'right track' with its current and future directions and remarkably consistent with the aspirations documented by the IAEA but there remained areas where the department needed focus and seek to improve its regulatory approach either by new initiatives or through the completion of existing initiatives. These initiatives include:

a. Seeking opportunities to increase transparency of aspects of the department's work
b. Completing the development of the risk management system
c. Completing the work health and safety project and leveraging that to ensure the department focuses on matters of safety in relation to regulatory work

d. Improving the department's communication efforts by maintaining its newsletter production and expanding to target key stakeholders directly. The department will also monitor the development of local public health units to look for opportunities to use their local standing in respect of local communication and engagement about significant mineral sand mining projects.
e. Improving the ways the department collects feedback from its stakeholders
f. Continuing to do more in respect of staff training for the department's highly specialist staff.
g. Completing the implementation of the department's information systems road map (discussed elsewhere in the report)
h. Implementing the latest version of nationally adopted codes (discussed elsewhere in the report)
i. Exploring the need and potential mechanisms for probity checks of body corporates and identity checks of individual applicants.
j. Regularly reviewing and documenting all aspects of the department's inspection programme to ensure that it focuses on risk, quality, sharing the findings amongst inspectors, communication to the affected stakeholders, timely follow up, etc.
k. Improving the department's use and monitoring of key performance indicators.
l. Developing a radioactive waste disposal policy to mandate disposal of long-lived sealed sources within a defined time period.
n. Reviewing the need for demonstration of financial assurance by some or all management licence applicants/licence holders) prior to the granting of licences to acquire certain types of radioactive material to demonstrate that sufficient funds are preserved to cover the cost of disposal
o. Improving the department's emergency response preparedness, including the role of licence holders.

Representation on national committees

enHealth

The Environmental Health Standing Committee (enHealth) is a standing committee of the Australian Health Protection Principal Committee (AHPPC). EnHealth is responsible for providing agreed environmental health policy advice, consultation with key stakeholders, and the development and coordination of research, information and practical resources on environmental health matters at a national level. The development of national advice by enHealth is based on significant collaboration and consultation with federal, state and territory agencies, departments and organisations that deal with environmental health matters.

The department was represented on enHealth over the reporting period by Dr Angie Bone, Deputy Chief Health Officer (Environment).

Radiation Health Expert Reference Panel

The Radiation Health Expert Reference Panel (RHERP) is a relatively new committee established in 2019 to provide advice to enHealth on specific issues as directed by the enHealth. RHERP has a particular focus on implementation of national agreements and will develop a National Strategy for Radiation Protection.

The department was represented on RHERP over the reporting period by Noel Cleaves, Manager Environmental Health Regulation and Compliance.

Radiation Health Committee

The role of the Radiation Health Committee is to advise ARPANSA's chief executive officer on matters relating to radiation protection, including formulating of draft national policies, codes and standards for consideration by the commonwealth, states and territories. During the year it focussed on the development of radiation safety technical standards and positions.

During 2021–22 the department was represented on ARPANSA's national Radiation Health Committee over the reporting period by Glenn Riley, Senior Policy Officer of the Radiation Team. Four meetings of this committee were attended during the financial year of which one was face to face and the remainder virtual.

ARPANSA publishes the agendas and minutes of these committee meetings <https://www.arpansa.gov.au/about-us/advisory-council-and-committees/radiation-health-and-safety-advisory-council>.

Australian Radioactive Waste Agency Waste Acceptance Standards Committee

The Commonwealth Government set up the Australian Radioactive Waste Agency in July 2020. The agency was set up to:

- manage Australia's radioactive waste in line with domestic and international regulations
- deliver and operate Australia's National Radioactive Waste Management Facility
- facilitate communication between government, industry, stakeholders and local communities
- centralise best practice and knowledge about radioactive waste management, including developing a disposal pathway for intermediate level radioactive waste.

The department has been asked from time to time to collect information from waste holders in Victoria to help create a national radioactive waste inventory. The department anticipates that such an inventory will inform decisions relating to the commonwealth's design and construction of the proposed National Radioactive Waste Management Facility in South Australia.

The department was represented on the Waste Acceptance Standards Committee of the Australian Radioactive Waste Agency over the reporting period by Dr Brad Cassels, Expert Adviser, Radiation Team.

Australian National Radiation Dose Register

The Australian National Radiation Dose Register (ANRDR) is a database designed to store and maintain radiation dose records for occupationally exposed workers. The ANRDR launched in 2011 for the Australian uranium mining and milling industry. The register now accepts dose records from all industries working with radiation, including the mining, medical, veterinary, industrial, aviation, research and university sectors. Many of the records are drawn from those of the personal radiation monitoring service providers discussed earlier.

The ANRDR is the nationally approved central record keeping agency for the dose records of all Australian workers who are occupationally exposed to ionising radiation. ARPANSA established the ANRDR to make sure workers' radiation dose records are kept in a centralised register, regardless of where or for whom a person is working.

The department has been advocating for improvements and a strengthening of the role of the ANRDR as a central part of Australia's radiation safety system. One important outcome of this advocacy has been focussing the project on developing nationally agreed accreditation standards for personal radiation dose monitoring service providers, discussed earlier in this report. The department has also advocated for a stronger governance system to guide development of the ANRDR and was pleased to see this progress during this financial year. The department now has a representative on an advisory body for the ANRDR and will continue to advocate for initiatives that strengthen the ANRDR as a cornerstone of Australia's radiation safety system.

Find out more about the ANRDR <https://www.arpansa.gov.au/our-services/monitoring/australian-national-radiation-dose-register>.

The department sees a strong relationship between developing the accreditation scheme for personal radiation dose monitoring service providers and the success of the ANRDR.

The department was represented on the ANRDR Advisory Board over the reporting period by Glenn Riley, Senior Project Officer, Radiation Team.

New national agreements and standards

National Directory for Radiation Protection (2nd Edition, 2021)

The purpose of the National Directory for Radiation Protection (NDRP) is to provide an agreed framework for radiation safety, including both ionising and non-ionising radiation, together with clear regulatory statements to be adopted by the commonwealth, states, and territories. Replacing the first edition of the NDRP approved by the Australian Health Ministers' Conference in July 2004 with subsequent amendments, this second edition (NDRP2) represents a modernisation and streamlined approach for the commonwealth, states, and territories to work towards in order to achieve the vision of a seamless regulatory framework for the safe use of radiation sources across Australia. It is likely that NDRP2 will eventually be superseded by the outcomes of the development of a future national radiation safety strategy.

National radiation safety strategy

The draft national strategy was developed by Australian jurisdictions with the aim of developing a consistent approach to radiation protection across Australia. It was released by the Commonwealth for comment during 2021 and is expected to be finalised during the 2022/23 financial year.

Regulatory expectations

A new national model has been developed that will feature publication of regulatory expectations for specific types of radiation practices. Development of nationally agreed regulatory expectations for regulated entities in relation to the Code for Radiation Protection in Medical Exposure (2019) (RPS C-5) are currently being finalised.

Accreditation standards for radiation dosimetry service providers

The conditions placed on management licences usually include requirements to monitor radiation doses to individuals using personal radiation monitoring devices. Radiation dose monitoring is a cornerstone of radiation safety. However, there are no nationally agreed guidelines that personal radiation monitoring service providers need to follow to guide aspects such as quality assurance. Regulation of these service providers is inconsistent across Australia. There is currently no direct regulation in Victoria of the providers of personal radiation monitoring services. The current service providers include both internationally and locally based companies and organisations.

The department is leading a national project to develop nationally agreed accreditation requirements to assess and approve these service providers and the associated personal dosimeters that they issue to their customers. The proposed requirements include:

- traceability of radiation doses to Australian national standards
- the requirement that personal dosimetry laboratories have a system in place to notify service users of high doses

- the requirement for a quality management system to be implemented for dose reports, including requirements to ensure consistent data reporting
- requirements for both the laboratory-based activities and for the services that support them
- a requirement for the service providers to provide radiation dose monitoring records to the Australian National Radiation Dose Register (maintained by ARPANSA).

If a national agreement on the scheme can be reached, then Victoria will need to make minor amendments to the Act to incorporate a new regulatory scheme to regulate in this area and to support these accreditation standards.

National radiation safety standards for medical diagnostic X-ray units

The department has been working with other jurisdictions on developing nationally consistent radiation safety standards for certain types of medical diagnostic X-ray units. If adopted, these standards would replace the current Victorian radiation safety standards for these types of X-ray units.

AUKUS

AUKUS is an enhanced trilateral security pact between Australia, the United Kingdom and the United States signed on 18 March 2022.

The Australian Department of Defence has stated:

> "The first major initiative under AUKUS is a trilateral program to support Australia in acquiring at least eight nuclear-powered submarines for operation by the Royal Australian Navy. … The Government has no intention to acquire nuclear weapons. Australia will remain a non-nuclear weapons state and will continue to meet its obligations under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and other relevant agreements, including with the International Atomic Energy Agency."

The initiative has been discussed at the Radiation Health Expert Reference Panel and it was noted that the draft national radiation safety strategy discussed above was developed prior to the announcement of the initiative. As a result, it is likely that the final strategy will acknowledge this development and the potential impacts for future radiation safety initiatives particularly relating to the need for specialist workforce development.

For this reason, the department will continue to monitor developments at the national level and will work with other jurisdictions on any consequential actions that follow from a national decision in this matter.

Focus on compliance monitoring

Monitoring the compliance of radiation practices with the requirements of the Act is primarily carried out through inspecting the practices. Where possible, the department works to promote compliance by providing advice and constructive guidance and by using technology and systems to help licence holders to interpret and comply with the laws and standards applicable to them.

The department conducted 170 inspections in the 2021–22 financial year as part of its licensing compliance monitoring program. This was below the Victorian State Budget target of 480 inspections. This shortfall was due to the impact of the pandemic over the reporting period. During the year, the department also conducted 57 virtual audits of radiation practices.

The compliance monitoring program included inspections of specific types of radiation practices to monitor compliance with safety or security standards but it also included inspections in relation to non-renewal of management licences.

Authorised officer uniforms

During the year, the Radiation Team commenced use of department branded shirts, jackets, coats and beanies which clearly show the wearer to be an authorised officer of the department. The team members now wear these during compliance monitoring inspection work and during any incident or emergency response to more clearly identify our staff as authorised officers of the department.

Focus on medical radiation

Compliance monitoring

An inspection program was commenced focusing on compliance with requirements pertaining to justification and approval of Computed Tomography procedures. The aim of the inspection program was to assess the quality of referrals for cardiac and non-cardiac Computed Tomography procedures and to ensure compliance with record keeping requirements pertaining to approval of medical radiation procedures. A total of 109 inspections (including 24 virtual inspections) were conducted of medical radiation practices over the reporting period.

The focus on requirements pertaining to justification and approval of Computed Tomography procedures will continue in the 2022–23 financial year.

Mandatory testing of medical diagnostic X-ray units

A prescribed radiation source may only be used for human diagnostic purposes if there is a current certificate of compliance in place. The department continued to monitor licensees for compliance with the testing requirements in 2021–22 and to monitor approved testers for compliance both with the conditions of their authorisation and with the provisions of the Act. A high level of compliance (at least 84%) was observed during the 2021–22 year.

Establishment of Radiotherapy Special Interest Group

The Radiotherapy Special Interest Group (RSIG) was established by the department to ensure that relevant information is shared between different groups within the department about this growing and complex area of medical radiation. The RSIG comprises team members from the Radiation Team, the Private Hospitals and Non-Emergency Patient Transport Regulation Branch, and the Cancer Support Treatment and Research area. Other sections within the department are advised and invited to join the groups meetings on an ad hoc basis. The RSIG meets every 4 months with the aim of:

- fostering a collaborative network within the department for the sharing of information between groups
- promoting and improving radiation therapy within Victoria
- discussing developments that impact on best practice and safety for radiation therapy
- removing obstacles to the department's successful delivery of radiation therapy services
- providing the necessary transparency of information for licensing new radiation therapy facilities and providers.

Coronial inquest into death due to anaphylactic reaction to contrast administered for a CT scan

The department followed a coronial inquest conducted into the death of a patient following a cardiac computed tomography (CT) procedure. The department reviewed the transcript of the coroner's inquest and the findings of the coroner.

The review highlighted deficiencies in the requirements pertaining to the justification and approval of medical radiation procedures. These deficiencies are discussed separately under the section titled "Justification of medical exposure".

Challenges

The Justification of medical exposure

The principle of justification is a well-established fundamental principle in radiation protection. The principle recognises that there may be some harm from exposure to radiation and seeks to ensure that such harm is only accepted if the radiation exposure is likely to result in a net benefit to the exposed individuals and/or society. The principle of justification forms a cornerstone of the Act and the *Code of Practice for Radiation Protection in the Medical Applications of Ionizing Radiation (2008)* (Medical Code) which is applied as a condition of licence in respect of all radiation sources used for medical purposes.

The Radiation Medical Practitioner as defined in the Medical Code is the person responsible for the justification of procedures involving the exposure of patients to ionizing radiation, either for each individual patient or by way of protocols specific for the procedure. In nuclear medicine, this person will normally be a Nuclear Medicine Specialist, in radiation oncology, this person will normally be a Radiation Oncologist, and in diagnostic or interventional radiology, this person will usually be a Radiologist, but might also be, for example, a Cardiologist or, for limited procedures, a General Practitioner.

Currently, the responsibilities of the Radiation Medical Practitioner as defined in the Medical Code are not imposed directly on the Radiation Medical Practitioner but rather indirectly by requiring the management licence holder to ensure that the responsibilities of the Radiation Medical Practitioner are met.

The department's compliance inspections and investigations have highlighted issues with this approach, and it will be reviewed as part of the implementation of the Code for Radiation Protection in Medical Exposure, Radiation Protection Series C-5.

Implementation of the Code for Radiation Protection in Medical Exposure (2019)

The department intends to implement this Code via delegate variations to approximately 6,500 relevant licences in the first quarter of 2023. It is critical that the health sector understands what Australian radiation safety regulators expect licence holders to be able to show when the Medical Code becomes mandatory.

Focus on veterinary radiation practices

Compliance monitoring

During the year there was a focus on compliance monitoring of veterinary radiation practices. An inspection program was commenced focusing on compliance with section 13 of the Act which makes an offence for a person to use a radiation source without a use licence unless that person is exempt from the requirement to hold a use licence.

The compliance monitoring led to a use licence held by a veterinarian being cancelled both on the grounds that the Veterinarian no longer held registration with the Veterinary Practitioners Registration Board of Victoria or an equivalent authority and on the reasons why the Veterinarian no longer held registration with the Veterinary Practitioners Registration Board of Victoria.

A total of eight inspections were conducted of veterinary radiation practices over the reporting period.

The focus on compliance monitoring in the Veterinary sector will continue in the 2022–2023 financial year.

Focus on dental radiation practices

Compliance monitoring

During the year, there has been a focus on compliance inspections of dental practices possessing 3D volumetric X-ray units.

There has been a significant growth in the number of licence holders being authorised to possess 3D volumetric X-ray units. This type of X-ray unit can generate detailed 3-dimensional images which are useful to support complex orthodontic procedures. However, the radiation dose to a patient and operator is greater than for other types of radiographic examinations. Due to the widespread introduction of this type of unit, there was a concern that they may be used where alternate imaging methods with a lower corresponding radiation dose would be more appropriate.

Inspections of licence holders authorised to possess 3D volumetric X-ray units has confirmed that they are being appropriately used, with alternative radiographic methods being used as a preference.

A total of 34 inspections were conducted of dental radiation practices over the reporting period.

The standards that the department applies as prerequisites for dental radiation practices performed by dentists were reviewed and updated to ensure the requirements are clear. Work has also been undertaken to define the process for the review and acceptance of training courses.

Victoria has a representative on the national working group developing a new code that will replace the Code of Practice and Safety Guide for Radiation Protection in Dentistry (2005).

Focus on industrial radiation practices

During the year there was a focus on compliance monitoring of industrial radiation practices involved in two separate sectors, firstly the transport of radioactive material and secondly the security of high consequence sealed sources.

An inspection program was commenced to target all companies authorised within Victoria to transport radioactive material. Compliance with the ARPANSA Code for the Safe Transport of Radioactive Material which is a condition of the management licence issued by the Department was assessed. The main area of focus being the transport companies' development and implementation of the Radiation Management Programme as required by the Code, which includes appropriate training of personnel, emergency response procedures and appropriate radiation monitoring during transport, among other things.

An inspection program was also commenced to audit the approved Security Plans of all licence holders within Victoria authorised to possess high consequence sealed sources. The program of inspections was to ensure that the Security Plans associated with the licence holders' possession of high consequence sealed sources were up to date and were fully implemented with all the required physical security measures in place.

A total of 72 inspections (including 24 virtual inspections) were conducted of industrial radiation practices over the reporting period. Note that this may include inspections of high consequence radioactive sources associated with other practice types including the medical sector.

Both focus areas will be continued for the 2022–23 financial year.

Compliance monitoring

Implementation of the Code of Radiation Protection Requirements for Industrial Radiography (2018)

The department intends to implement this Code via delegate variations to relevant licences in the first quarter of 2023.

Implementation of Code for the Safe Transport of Radioactive Material 2019

The department intends to implement this Code via delegate variations to relevant licences in the first quarter of 2023.

Focus on mining of mineral sands and rare earths

The department regulates the processing, storage, transport and disposal of the naturally occurring radioactive material associated with mineral sand mining and processing. The mining of mineral-rich sands within Victoria generally triggers the need to regulate the radiation safety aspects of the operations due to the presence of naturally occurring radioactive material in low concentrations. Mineral sands within Victoria are usually mined from ancient beaches, like those that existed in the Murray Basin. Mineral sands were deposited on shores where the large density of the mineral sand grains allowed them to settle close to the then existing shore and be concentrated there while lighter sands tended to be washed out to sea. There are currently two companies licensed under the Act to conduct mineral sand mining and processing in Victoria – Iluka Resources Limited and Donald Mineral Sands Pty Ltd.

Other projects have been proposed and are currently at varying stages of the required development assessment process, which typically includes a formal environmental effects assessment. The first five mineral sands projects discussed below are in the Murray Basin; the sixth is in eastern Gippsland.

A total of four inspections were conducted of mineral sand mining and processing sites over the reporting period.

Current and proposed mine sites

Iluka Resources Limited – existing operations

Iluka Resources Limited has been mining mineral sands in the west of Victoria since 2005 in the Kanagulk and Ouyen areas. Part of its operation includes disposing of waste by-products that were generated by processing heavy mineral concentrate (HMC) at its mineral separation plant in Hamilton into the disposal pit at its Douglas mine site in western Victoria, known as Pit 23. The mineral separation plant in Hamilton is currently not operating. Disposal of the by-products from the processing of HMC into Pit 23 began in 2011. The HMC was produced by mining activities at various Iluka mines, including those at Ouyen and in South Australia. The continued disposal of these by-products involved Iluka obtaining a planning permit from Horsham Rural City Council. The department sits on the technical reference group that advises Horsham Rural City Council in relation to Iluka's planning permit for disposing of waste by-products into Pit 23. The department's regulation of Iluka's operations involving the possession of radioactive material will continue until the rehabilitation of the mine sites at Kanagulk and Ouyen has been completed.

Iluka Resources Limited – Wimmera Mineral Sands Project

Iluka Resources Limited proposes to develop the Wimmera Mineral Sands project, which has an approximate area of 2,600 hectares and is about 35 kilometres southwest of Horsham. This WIM100 deposit is reported to have about 200 million tonnes of heavy mineral sands ore, which is proposed to be extracted and refined onsite to produce zircon, titanium oxide and rare earth products.

The proposal includes:

- developing a mineral sands mine
- processing plants (including a mineral separation plant, zircon refinery and rare earth refinery)
- an ore receival and liquification system
- mine by-products transport and containment infrastructure
- offsite infrastructure such as powerlines, water pipelines, access roads and a temporary construction camp
- additional offsite infrastructure such as administration buildings, water storage dams, fuel storage and laydown areas.

The proposed mining method is likely to be progressive mining using mobile earthmoving equipment. Nine to 10 million tonnes of ore per annum is proposed to be extracted, which will be refined onsite to produce 192,000 tonnes of recoverable mineral product per annum, over the projected 25-year life of the mine. The Department of Environment, Land, Water and Planning (DELWP) has convened a technical reference group to advise the proponent and the department, as appropriate, on scoping and adequacy of the studies while preparing the required environment effects statement. The department's Radiation Team is part of this group.

Find out more from the Department of Environment, Land, Water and Planning website <https://www.planning.vic.gov.au/environment-assessment/browse-projects/projects/wimmera-mineral-sands>.

Donald Mineral Sands

The site for this project is about 17 km southeast of Minyip. Donald Mineral Sands is planning to mine the shallow, fine-grained sand deposit containing accumulations of titanium and zirconium minerals. The valuable minerals (ilmenite, rutile, leucoxene and zircon) will be separated into a heavy mineral concentrate and then exported. The remaining non-valuable clays and sands will be returned to the soil profile. The final rehabilitation of the mined area is intended to produce a landscape similar to that prior to the mining project, including restoration of native vegetation, drainage and agriculturally productive land. The project underwent an environment effects assessment process in 2008. Donald Mineral Sands Pty Ltd was issued, and still holds, a radiation management licence to undertake mining and processing of mineral sands. The company has not yet begun operations. The department has in previous financial years carried out a program of radon monitoring in the area of the proposed mine to establish a baseline level of radon for comparison with levels during any future mining activities. Find out more about the project from the Astron website <https://www.astronlimited.com.au/astron-mineral-sands-projects/donald-mineral-sands-project/>

VHM Limited – Goschen Mineral Sands and Rare Earths project

VHM Limited proposes to develop the Goschen Mineral Sands and Rare Earths project, which has an approximate area of 8,300 ha and is about 20 km south of Swan Hill. The Goschen deposit is reported to contain have around 300 million tonnes of ore and is proposed to produce a zircon and rutile concentrate, a titanium concentrate and a rare earth concentrate. The proposal includes:

- a mineral sands mine
- a mining unit plant
- a wet concentrator plant
- an interim tailings storage facility
- solar drying beds for tailings
- slurry pipelines to transfer ore from pits to the processing facilities
- additional site infrastructure such as site office, warehouse and workshop facilities, loading facilities and fuel storage.

Proposed mining methods involve open-pit mining to extract approximately five million tonnes of ore per annum, increasing to 10 million tonnes of ore per annum over a projected mine life of 30 years. Mine products are proposed to be transported via road or by rail for export overseas. DELWP convened a technical reference group to advise the proponent and the department, as appropriate, on scoping and adequacy of the studies while preparing the environment effects statement. The department's Radiation Team is represented on the group. Find out more about this project from the Department of Environment, Land, Water and Planning website <https://www.planning.vic.gov.au/environment-assessment/browse-projects/projects/goschen-mineral-sands-and-rare-earths-project>.

WIM Resources – Avonbank Heavy Mineral Sands project

WIM Resources Pty Ltd proposes to develop the Avonbank Heavy Mineral Sands project, which has an approximate area of 2,500 ha and is about 15 km northeast of Horsham. The Avonbank deposit is reported to contain around 300 million tonnes of ore, and the company proposes to produce a heavy mineral concentrate containing zircon, rare earths and titanium minerals.

The proposal includes:

- a mineral sands mine
- a wet concentrator plant
- starter ore and overburden stockpiles
- slurry pipelines
- additional site infrastructure such as a site office, warehouse, workshop, rail loading facilities and fuel storage.

The proposed mining methods involve open-pit mining to extract 9–15 million tonnes of ore per year over a projected mine life of 30 years to produce 350,000–600,000 tonnes of heavy mineral concentrate per year. Mine products are proposed to be transported via road or rail for export overseas. DELWP convened a technical reference group to advise the proponent and the department, as appropriate, on scoping and adequacy of the studies while preparing the environment effects statement. The department's Radiation Team is represented on the group.

Find out more about this project from the Department of Environment, Land, Water and Planning website <https://www.planning.vic.gov.au/environment-assessment/browse-projects/projects/avonbank-mineral-sands>.

Kalbar Operations – Fingerboards Mineral Sands Project

Kalbar Operations Pty Ltd proposed to develop the Fingerboards Mineral Sands Project, which has an approximate area of 1,675 ha and is about 20 km northwest of Bairnsdale in East Gippsland.

The proposal included:

- a mineral sands mine
- two mining unit plants
- a wet concentrator plant (comprising mineral separation processing and tailings thickening plant)
- water supply infrastructure
- a tailings storage facility or centrifuge facility to offset any requirement for tailings storage
- more site facilities such as a site office, warehouse, workshop, loading facilities and fuel storage.

The proposed mining methods involved open-pit mining to extract about 170 million tonnes of ore over a projected mine life of 20 years to produce around eight million tonnes of mineral concentrate. Mine products were proposed to be transported via road or by rail for export overseas. DELWP convened a technical reference group to advise

the proponent and the department, as appropriate, on scoping and adequacy of the studies while preparing the environment effects statement. The department was actively involved in the technical reference group meetings for this project to ensure potential radiation exposures are properly addressed and that the project established programs to obtain and collate the information the department needed to assess the potential radiation impact on human health and the environment. The department made a submission to the inquiry established by the Minister for Planning to assess the environmental impacts of the project.

On 21 November 2021, the Minister for Planning completed his assessment under the Environment Effects Act 1978. His assessment stated that 'It is my assessment that the project would have unacceptable environmental effects'.

He stated in his assessment that 'The unacceptable effects relate primarily to effects on native vegetation, biodiversity, air quality, agriculture and horticulture, and social values within the project area and its surrounds. The project also poses an unacceptable risk to surface water values downstream of the site.'

The Minister's assessment also made a number of comments relating to radiation safety. These are summarised below:

He acknowledged that 'as the predicted dose rates to the public and workforce are considerably below the prescribed dose limits and there is a strong regulatory framework for the management of radiation in Victoria, the potential radiation impacts from the project are likely to be manageable to an acceptable level.'

He did express concern about the potential for significant dust effects and the potential for radionuclides to be carried off-site as a result of dust emissions. He acknowledged the recommendation of the Inquiry and Advisory Committee that further detailed assessments would be required by the department to inform any potential approval of the project. He recommended that if the project did proceed that the department 'should consider making the radiation management plans for this project publicly available, where possible'.

The Minister's assessment and further background on the proposed project is published at the Department of Environment, Land, Water and Planning website <https://www.planning.vic.gov.au/environment-assessment/browse-projects/projects/fingerboards-mineral-sands>. The environment effects statement process for this project has now been concluded.

Focus on commercial tanning practices

Under section 23D of the Act, it is an offence to conduct a commercial tanning practice.

During the year the department became aware of 30 potential breaches of section 23D of the Act. To date there has not been sufficient evidence obtained to take 29 of these matters further but investigations in this area are complex and remain ongoing.

However, sufficient evidence was obtained to enable a search warrant to be obtained and executed for one matter relating to a Doncaster property. This search resulted in the seizure of five tanning units. The matter remains under investigation. This search and seizure were featured in a Channel 7 News report on 30 June 2022.

Two prosecutions related to investigations that commenced in previous years were completed during the year. One prosecution related to a Thomastown property that was searched in 2018 with four tanning units seized. It resulted in three individuals being convicted and fined a total of $30,000 and ordered to pay a total of $15,000 in costs.

The second prosecution related to a Southbank property that was searched in 2021 with one tanning unit seized. It resulted in one person being fined $2,500 with $3,500 costs without conviction.

Once the tanning beds are forfeited to the department, the components in the ultraviolet light tubes, including the glass and mercury, are safely removed and recycled and the tanning beds destroyed.

Regulatory policy and continuous improvement

Future directions

During the year, work was conducted to review longer term directions in this area. The work reinforced:

- The need to continue to reduce the volume of transactional work as far as is possible to allow subject matter experts to focus on radiation safety matters. Full implementation of the licensing portal has and will continue to assist in this area. Similarly, the department is developing a web-based contact system where stakeholders will be able to enter queries and lodge requests to reduce the volumes of emails that are generated through this programme.
- The need to improve our data reporting and analysis capabilities.
- Continuing to improve our relationships with key stakeholders, particularly those groups that represent many individual or corporate licence holders
- Moving to increase transparency around aspects of our work. This report is part of that process but over time the department will move to establish better reporting systems on our web site about key indicators including processing times.
- Continuing to review and improve preparedness for incidents and emergencies involving radioactive material
- Improving the way that the department identifies and manages risks in this area.

Implementing the Code for Radiation Protection in Planned Exposure Situations

The department has worked through a number of issues relating to implementing the ARPANSA *Code for Radiation Protection in Planned Exposure Situations (Rev.1) (2020)* (Planned Exposure Code). Some of the key elements of the Planned Exposure Code are the wide-ranging applicability of the code and the requirement to develop a safety assessment to be conducted that is either generic or specific to the radiation source or facility (a 'graded approach'), to be submitted to the regulator before the granting of an authorisation. The Planned Exposure Code was endorsed by Australian health ministers in the second half of 2021.

The department has advised stakeholders of its intention to make variations to **all** management licences to require compliance with this code from 1 January 2023.

The department has also amended its licensing prerequisites to bring them into line with other jurisdictions and requires a radiation management plan (RMP) to be submitted with:

- applications for new management licences
- variations to existing management licences
- applications to transfer an existing management licence to another person or body corporate.

This requirement for a RMP will enable a more gradual move to the use of RMPs by all practices before implementing the code.

Ionising radiation dose limits review

Work commenced during the latter part of the financial year on a review of the changes that will be required to the regulations to implement the ionising radiation dose limits contained in the Planned Exposure Code. These dose limits are drawn from international standards but are often complex and difficult to implement in a legal framework. Work will continue during 2022/23.

Radiation shielding assessments

The department had identified deficiencies in the quality of radiation shielding assessments and the adequacy of installed radiation shielding in three key areas:

- insufficient shielding being specified at the initial shielding design stage
- insufficient shielding being installed, or shielding being installed incorrectly
- lack of regular review to ensure the shielding parameter values (for example, workload, occupancy and distances from radiation sources) on which the shielding design was based have not changed from those used in the approved shielding assessment in such a way that the shielding assessment is no longer valid.

The department has developed a draft shielding standard that prescribes the requirements for a shielding assessment. The department will seek public comments regarding the draft standard in the 2022–23 financial year.

In conjunction with the standard, the department proposes to introduce an approval framework for shielding assessors. This framework would require assessments to be performed by an approved shielding assessor and approved shielding assessors to comply with the shielding design standard.

The department has introduced an online shielding self-assessment tool for veterinary practices. This online shielding self-assessment tool will be further developed in the future to include other low-risk practices.

Sewer waste disposal project

Work is continuing on the development of a framework for the regulation of disposal of radioactive waste to sewer in preparation for the implementation of parts of the Code for the Disposal of Radioactive Waste by the User (2018). This code relates to the disposal and discharge of radioactive material containing relatively low levels of radioactivity, or radionuclides of short half-life, such as are generated by medical, industrial and research uses of radioactivity. The main changes resulting from the requirements imposed by the code are:

a. the move to using an annual (total) activity limit on the amount of radioactive waste that can be disposed of via sewer rather than specifying a radioactive concentration limit for the waste, and
b. patient excreta no longer being excluded from the requirements.

Work is being undertaken to develop the regulatory requirements with the intention of implementing the new requirements in 2023.

Intense pulsed light sources and lasers

The department has received a number of enquiries over the year expressing concerns about the safe use of lasers. These have included concerns relating to lasers in night clubs and bird deterrent lasers being used near residential properties.

There have also been a number of media reports relating to burns associated with the cosmetic use of lasers and intense pulsed light sources (IPL). This area is not currently regulated by the department. Guidance on the safe use of IPL/lasers is available from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) website <https://www.arpansa.gov.au/understanding-radiation/radiation-sources/more-radiation-sources/intense-pulsed-light-sources-used-for-cosmetic-purposes>.

Focus on emergency preparedness and response

Under Victoria's emergency management arrangements the department is the control agency for radiological emergencies where radiation is the principal hazard. As part of this responsibility the department maintains a 24/7 response capability involving specialist radiation safety staff. Staff have access to vehicles with specialist radiation safety detection equipment and ancillary equipment. More equipment was purchased during the year using a portion of the funds allocated in the November 2020 Victorian State Budget.

The radiation monitoring equipment the department has includes:

- radiation survey meters
- a telescopic radiation monitor survey meter (approximately 3m extension)
- handheld radionuclide identification instruments
- contamination monitors
- wipe sample counting systems that can be deployed in the field
- an air-sampling instrument that can be deployed in the field
- personal electronic radiation dosimeters for all radiation regulatory staff
- a radiation portal monitor for high-volume screening of people for radioactive material contamination.

One of the challenges for the department is how best to maintain a response capability for what are clearly extremely low-likelihood but potentially high-consequence events.

Over the past year there have been a number of developments commenced or completed including:

- working with a specialist training provider to deliver a tailored week-long incident training response course in early 2023 for the department's radiation specialists
- increasing the number of radiation specialists who are on call 24/7 from two to three. The new arrangement will improve the management of on-site response by improving coordination of any radiation response
- working to replace the unit's two response vehicles to enable easier access to radiation monitoring equipment in the field
- preparations for a review of the preparedness for radiation incidents including clinical management
- working with public hospital Emergency Department Field Emergency Medical Officers (FEMO) and the Australian Radiation Protection and Nuclear Safety Agency on a 2-day training course for FEMO's and the department's public health physicians on radiation response.

Radiation incidents

Management licence holders must, by a condition of their licence, report incidents that are described in the department's document Mandatory reporting of radiation incidents <https://www2.health.vic.gov.au/public-health/radiation/licensing/management-licenses-businesses/general-conditions/incident-reporting>.

Any incident that meets one or more of the following criteria is required to be reported to the department:

- becoming aware of the loss or theft of a radiation source
- any breach of security relating to the possession or transport of a high-consequence sealed source
- a worker, patient 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
- the activity of the material administered to a patient during the administration of radioactive material for human diagnostic purposes exceeds the activity prescribed in the hospital/practice standard protocol for that test by 50 per cent or more
- the activity administered to a patient during the administration of a radioactive material for human therapeutic purposes differs from that prescribed by 15 per cent or more
- the dose delivered during administration of a human therapeutic dose of radiation to a patient from a radiation apparatus or a sealed radioactive source:
  - differs from the total prescribed treatment dose by more than 10 per cent
  - the difference between the total prescribed dose and the delivered dose was not anticipated or accepted as part of the treatment plan
- any human therapeutic treatment delivered to either the wrong patient or the wrong tissue, or using the wrong radiopharmaceutical
- any human diagnostic procedure other than as prescribed that could lead to an effective dose exceeding 1 mSv (including the wrong patient or the wrong body part examined)
- any human diagnostic procedure resulting in an observable acute radiation effect
- 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
- any observable radiation injury (note that effects such as erythema, which are expected to occur following therapeutic procedures, do not need to be reported)
- 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
- where a surface, substance or material is or has been contaminated by radioactive material in excess of:
  - 1 kBq within any square metre in the case of alpha-emitting radioactive material, or
  - 1 MBq within any square metre in the case of beta-emitting or gamma-emitting radioactive material
- a transport accident involving radioactive material where there has been damage or possible damage to containers that contain a sealed source, sealed source apparatus or radioactive material
- a transport accident involving radioactive material where there has been a spill or release of radioactive material into the environment.

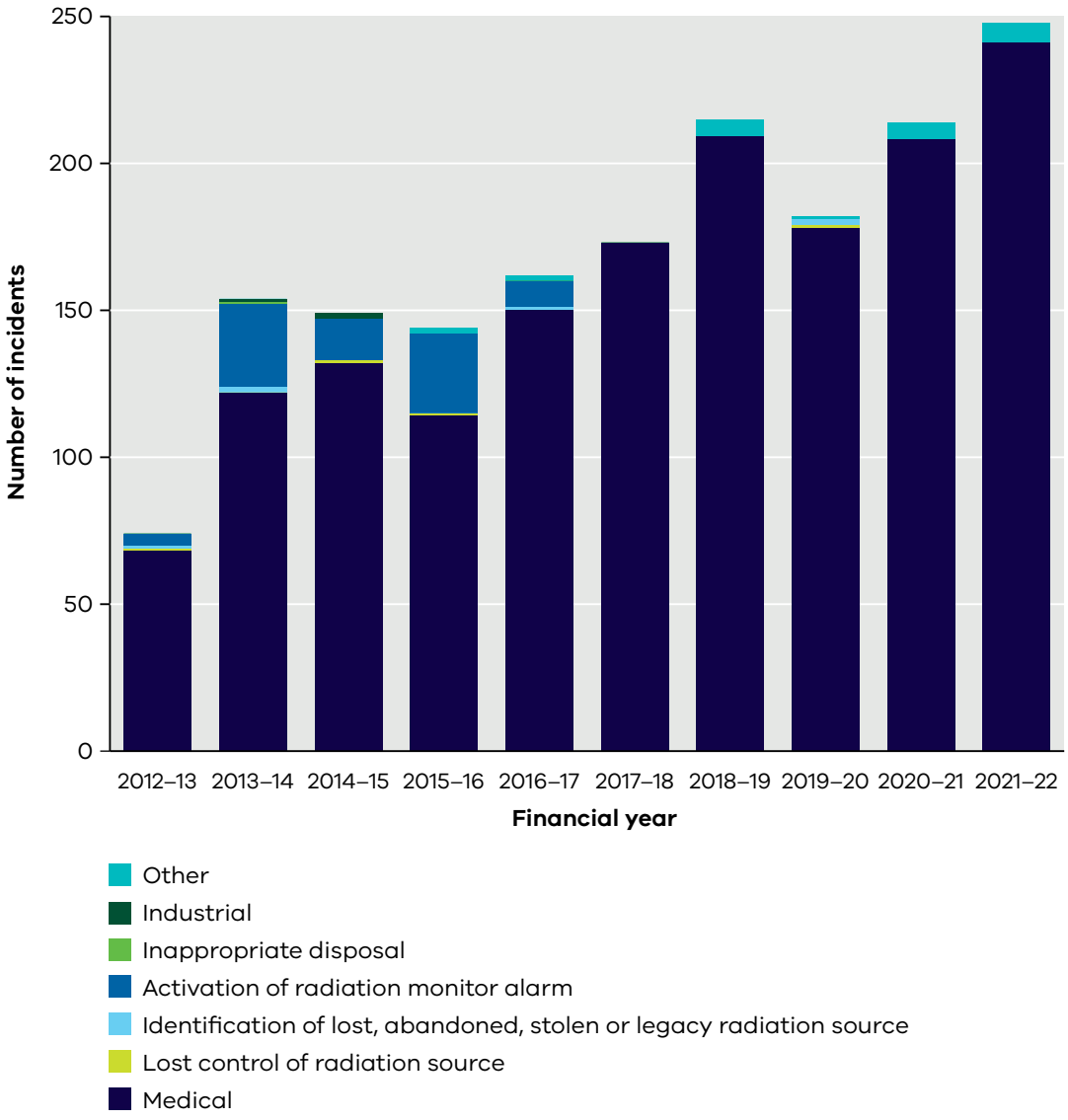
Incidents reported during 2021–22

During 2021–22, 248 incidents were reported to the department compared with 214 in the previous year.

Of the 248 incidents in 2021–22, 245 were in the medical sector. Most medical incidents involved unplanned exposure or additional exposure to patients as a result of errors in patient management or as a result of equipment error. None of the incidents involved any compromise in security of high consequence sealed sources.

The incidents reported in 2021–22 are summarised in Tables 7 and 8 of Appendix 1. Figure 1 below presents an overview of reported incidents over the past 10 years.

Figure 1: Overview of reported incidents over the past 10 years



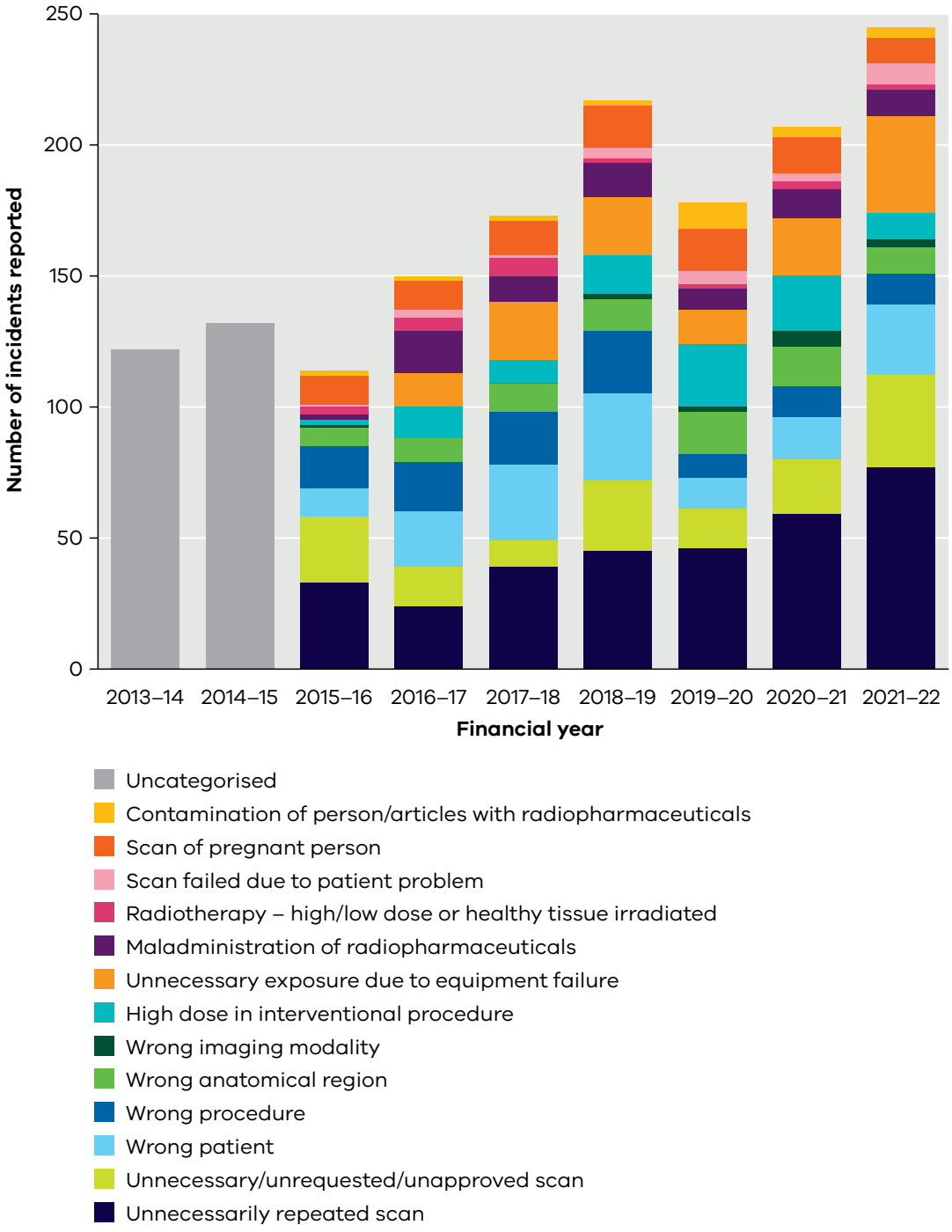
The number of incidents reported to the department has increased over the last 10 years with the vast majority of reported incidents occurring in the medical sector. The numbers of incidents in the various medical radiation incident categories per financial year from 2015 to 2022 are shown in Table 5. The data are only presented for 2015 to 2022 as medical incidents were not categorised in previous years.

Table 5: Medical radiation incidents by categories per financial year, 2015–16 to 2021–22

Incident type	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22
Unnecessarily repeated scan	33	24	39	45	46	59	77
Unnecessary/unrequested/ unapproved scan	25	15	10	27	15	21	35
Wrong patient	11	21	29	33	12	16	27
Wrong procedure	16	19	20	24	9	12	12
Wrong anatomical region	7	9	11	12	16	15	10
Wrong imaging modality	1	0	0	2	2	6	3
High dose in interventional procedure	2	12	9	15	24	21	10
Unnecessary exposure due to equipment failure	0	13	22	22	13	22	37
Maladministration of radiopharmaceuticals	2	16	10	13	8	11	10
Radiotherapy - high/low dose or healthy tissue irradiated	3	5	7	2	2	3	2
Scan failed due to patient problem	1	3	1	4	5	3	8
Scan on pregnant person	11	11	13	16	16	14	10
Contamination of person/articles with radiopharmaceuticals	2	2	2	2	10	4	4
Total	**114**	**150**	**173**	**217**	**178**	**207**	**245**

The total number of medical incidents is also represented in Figure 2. Data have been included for the 2013–14 and 2014–15 financial years although the incidents in these years are uncategorised.

Figure 2: Number of medical radiation incidents by category



The number of reported medical incidents in 2021–22 continues the trend of increasing numbers of such incidents over the past 10 years. The number of medical imaging procedures that involve ionising radiation has also increased over the same period of time. It is therefore to be expected that the number of incidents occurring would also increase if the incident rate per procedure did not vary over time. It is important to determine whether the observed increase in the number of reported incidents is attributable solely to reflect the increase in the number of medical procedures performed or whether the increase in reported incidents is due to an increase in the incident rate per procedure.

Table 6 summarises the number of medical incidents reported since the 2013–2014 financial year along with the number of nuclear medicine and CT medical imaging procedures performed and the incident frequency, expressed as the number of incidents per 100,000 procedures. The number of medical imaging procedures performed was obtained from Medicare Australia statistics. It should be noted that the Medicare Australia procedural data:

1. are not a complete representation of all medical radiation procedures performed as they exclude procedures that are not covered by Medicare. However, the data are considered to be sufficiently representative of the relative increase in total number of procedures performed; and
2. only include CT and nuclear medicine imaging procedures because most of the reportable incidents occur with CT and nuclear medicine imaging modalities. Procedures performed with these modalities almost always result in doses to patients of 1 mSv or greater. Consequently, the dose to a patient as a result of an incident involving one of these modalities is much more likely to exceed the 1 mSv threshold for reportable incidents than for incidents involving other modalities (e.g. general X-ray and mammography).

Table 6: Medical radiation incidents by categories per financial year

Financial year	No. of medical incidents reported	No. of diagnostic imaging services (CT and nuclear medicine only)	Incident frequency (per 100,000 CT and nuclear medicine diagnostic imaging procedures)
2013–2014	122	675,981	18.0
2014–2015	132	815,525	16.2
2015–2016	114	819,462	13.9
2016–2017	150	887,298	16.9
2017–2018	173	946,310	18.3
2018–2019	217	993,218	21.8
2019–2020	178	1,018,872	17.5
2020–2021	207	1,126,448	18.4
2021–2022	245	1,149,761	21.3
Average			18.2

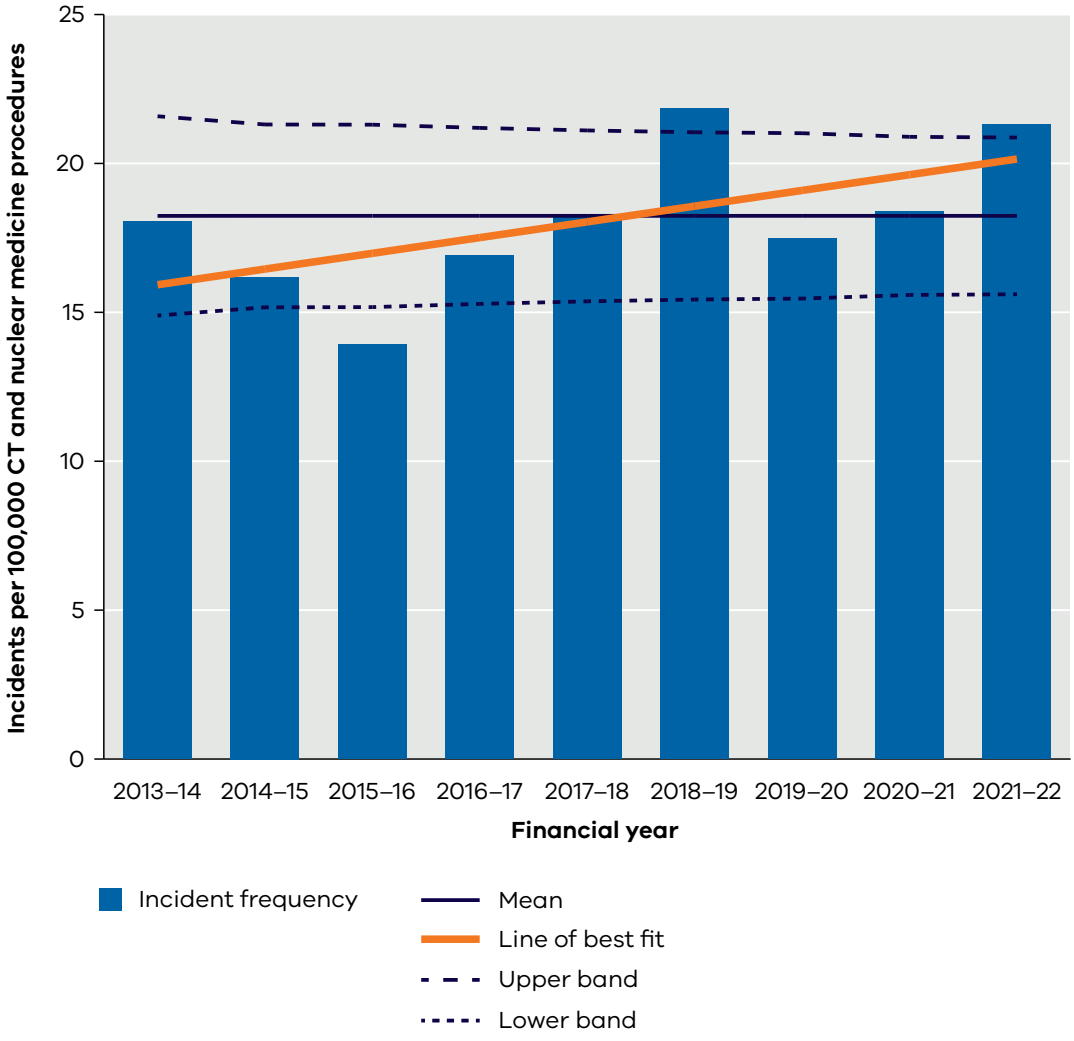
Table 6 shows that the total number of CT and nuclear medicine procedures has steadily increased since 2013-2014. The incident frequency per 100,000 CT and nuclear medicine diagnostic imaging procedures seems to show a small upward trend over time.

Further analysis can be conducted to determine if the difference between the incident frequency in a given year and the mean incident frequency over the last nine years is statistically significant, i.e., whether or not the frequency of incidents reported each year lies within the 95% confidence intervals of the mean[1].

1 Assuming that the base frequency, or probability, of incidents occurring was constant, some variation about a mean would be expected each year due to the random nature of incidents occurring. It can be shown that the number of incidents occurring within a given time interval, such as a year, can be modelled using a binomial distribution. Where the probability of an incident occurring is small, such as in this case, the distribution can be approximated using a Poisson distribution. A Poisson distribution can be approximated by a standard distribution with a standard deviation of √N for sufficiently large N, where N is the number of occurrences of phenomena under investigation, in this case the number of incidents.

Based on the average frequency of 18.2 incidents per 100,000 CT and nuclear medicine procedures, the expected range of the frequency in any given year is approximately 15.4 to 21.1 incidents per 100,000 procedures, based on a 95% confidence interval. A comparison of the frequency of incidents for each year with the confidence intervals is shown in Figure 3.

Figure 3: A comparison of the frequency of incidents for each year with confidence intervals



It should be noted that the actual lower and upper confidence levels will vary slightly from year to year as they depend on the total number of procedures in a given year. As a result, the lines on the figure corresponding to these confidence levels are not completely flat.

The figure shows that the frequency of incidents occurring in most years lies within the expected range. There are only three outliers. The 2015–16 incident frequency is a low-level outlier (p-value of 0.0056) while the years of 2018–19 and 2021–22 are both high-level outliers (p-values of 0.0117 and 0.0222 respectively). It can also be seen that there has been a general increase in the frequency of reported incidents over the last 10 years. The rate of increase based on the line of best fit is 0.53 incidents/100,000 procedures/year. This increase, although small, is statistically significant (p-value < 0.01).

Reasons for the increase in the frequency of reported medical radiation incidents over the past 10 years are not well known. The categories that appear to have the most significant upward trends include "Unnecessarily repeated scan", "Unnecessary/unrequested/unapproved scan" and "Unnecessary exposure due to equipment failure".

One possible factor contributing to an increase in the incidents due to equipment failure may be the increasing complexity of equipment used, primarily CT, SPECT/CT and PET/CT equipment, for which there may be a greater likelihood of equipment failure. Another factor contributing to the increase in reported incidents in general may be the increased awareness among licensees of the requirement to report medical incidents: this awareness has been increased significantly over the last 10 years as a result of the department's increased focus on regulating the medical use of radiation. Ultimately, it is difficult to draw any firm conclusions from the available data.

Further investigation is required to obtain suitable details for all radiation incidents and to evaluate those incidents based on factors such as underlying causes, licence holder type, equipment type/manufacturer, etc. This will allow a better understanding of the range and frequency of the proximate and ultimate (root) causes of radiation incidents with the aim of identifying areas that the department can focus on in an attempt to reduce the frequency of these incidents in the future. This will be a focus in 2022–23.

Appendix 1: Radiation incident details

As a guide to the radiation doses mentioned in Table 6, the public exposure limit is an effective dose of 1 millisievert (1 mSv) per year, while for occupational exposure the limit is an effective dose of 20 mSv per year.

The **becquerel (Bq)** is the standard unit of radioactivity.

1 kBq = 1,000 Bq

1 MBq = 1,000 kBq

1 GBq = 1,000 MBq

1 TBq = 1,000 GBq

The **sievert (Sv)** is the unit of effective dose of radiation and is used as a measure of risk of developing cancer and other late-onset effects.

1,000 mSv = 1 Sv

The **gray (Gy)** is the unit of absorbed dose of radiation and is used as a measure of the likelihood of development of foetal malformations and of developing acute effects such as skin burns.

1,000 mGy = 1 Gy

Radioactive sources

^{18}F	fluorine-18
^{51}Cr	chromium-51
^{68}Ga	gallium-68
^{131}I	iodine-131
^{177}Lu	lutetium-177
^{99m}Tc	technetium-99m

Imaging modality acronyms

AEC	automatic exposure control
DXA	dual energy X-ray absorptiometry
CT	computed tomography
CTPA	CT pulmonary angiogram
PET	positron emission tomography
PET/CT	positron emission tomography/ computed tomography

Pharmaceuticals

DMSA	dimercaptosuccinic acid
DISIDA	diisopropyl iminodiacetic acid
DOTATATE	an amino acid peptide (tyrosine-3-octreotate)
DTPA	diethylene-triamine-pentaacetate
ECD	ester dihydrochloride
FET	fluoroethyl-l-tyrosine
FDG	fluorodeoxyglucose
HDP	hydroxydiphosphonate
HMDP	hydroxymethylene diphosphonate
HIDA	hepatobiliary iminodiacetic acid
HMPAO	hexamethylpropyleneamine
MAG3	mercaptoacetyltriglycine
Mebrofenin	a radiopharmaceutical used for imaging of the liver and the gallbladder
MAA	macroaggregated albumin
MAG3	mertiatide
MIBI	methoxy-isobutyl-isonitrile
MDP	methyl diphosphonate
Nanoscan	a colloid used for bone marrow scans and to label white blood cells for inflammation/infection imaging

Table 7: Radiation Act incident summary, 2021–2022

Incident type	Number
Unnecessarily repeated medical imaging procedures	77
Unnecessary radiation exposure due to equipment failure	37
Unnecessary, unrequested or unapproved medical procedures	35
Wrong patient underwent a medical procedure	27
Patient underwent incorrect medical procedure	12
Patient underwent a medical procedure on the wrong anatomical region	10
High patient dose during an interventional or fluoroscopic procedure	10
Maladministration of radiopharmaceutical	10
A pregnant person was exposed to radiation	10
Medical procedure failed due to patient non-cooperation or other patient problem	8
Contamination of persons or articles with a radiopharmaceutical	4
Patient underwent a medical procedure using the wrong modality	3
Radiotherapy – unintended irradiation of healthy tissue or over/ underdose to target tissue	2
Finding of potentially radioactive material	1
Sealed source apparatus lost or missing	1
Incident involving unsealed radioactive material	1

Table 8: Radiation Act incidents, 2021–2022

Unnecessarily repeated medical imaging procedures

Incident no.	Description of incident
Incident 1	**A patient had an unnecessarily repeated nuclear medicine scan due to extravasation of a radiopharmaceutical.** A patient at a medical imaging practice was to undergo a nuclear medicine cardiac scan involving the injection of about 408 MBq of ^{99m}Tc-MIBI. The radiopharmaceutical extravasated during the injection (was injected outside of the vein), necessitating a repeat injection. The effective dose due to the first injection was less than about 2.5 mSv. No other action was necessary.
Incident 2	**A patient had an unnecessarily repeated nuclear medicine scan due to extravasation of a radiopharmaceutical.** A patient presented to a hospital for a rest/stress myocardial perfusion scan. An experienced nurse inserted an intravenous (IV) line into the cubital fossa. The line was patent and working as expected for the resting injection and the flush prior to the stress test. There was, however, extravasation of the ^{99m}Tc-MIBI during the stress component of the test. The stress component of the test required an additional ^{99m}Tc-MIBI dose had to be injected. The effective dose due to the first stress injection was less than about 7 mSv. No other action was necessary.
Incident 3	**A paediatric patient had an unnecessarily repeated CT scan due to extravasation of contrast agent.** A paediatric hospital patient was to undergo a contrast CT scan of the abdomen and pelvis. All appropriate checks on the cannula for the contrast administration were performed and indicated that the cannula was placed correctly. After the CT scan was performed, the radiographer noticed that there was no contrast in the images. A second cannula was inserted and the scan was repeated successfully. The effective dose due to the first scan was about 5.7 mSv. No other action was necessary.
Incident 4	**A paediatric patient had part of a CT scan unnecessarily repeated due to radiographer error.** A paediatric hospital patient required a contrast CT scan of the chest but the radiographer involved did not attach the contrast injector line to the patient prior to the start of the test bolus injection and associated CT imaging. The scan was stopped when the radiographer realised the error. The radiographer connected the contrast injector line and the test bolus scan was restarted. The effective dose for the repeated CT scan was about 0.1 mSv. The radiographer was reminded to concentrate on the scan being carried out.
Incident 5	**A patient had a CT scan unnecessarily repeated due to radiographer error.** A hospital patient was scheduled for a CT scan of the kidneys, ureters and bladder (KUB) with and without contrast. Contrast was administered prior to the non-contrast CT KUB acquisition. The contrast administration should have occurred after the non-contrast CT KUB acquisition. The effective dose for the unnecessary CT scan was about 6.2 mSv. The radiographer was reminded to concentrate on the scan being carried out.
Incident 6	**A patient had a CT scan unnecessarily repeated due to radiographer error.** A hospital patient was referred for a CT pulmonary angiogram. During image acquisition, the contrast injector was not commenced at the time the scanner was initiated. This was not identified until after the acquisition was completed and the imaging was obtained without contrast. The scan had to be repeated with contrast. The effective dose for the unnecessary CT scan was about 5.7 mSv. The radiographer was reminded to concentrate on the scan being carried out.

Unnecessarily repeated medical imaging procedures (continued)

Incident no.	Description of incident
Incident 7	**A patient had a CT scan unnecessarily repeated due to radiology registrar error.** A hospital patient was referred for a 4 phase CT scan of the liver. The treating team indicated that patient had already received a 4 phase CT scan of the liver in the weeks prior to the hospital admission. A radiology registrar advised that the procedure should not go ahead and told the treating team to cancel the examination on the electronic medical record. The treating team noted on the electronic medical record that imaging was not required and also notified bedside nurse and radiology booking staff. A second radiology registrar later justified the procedure, without checking the electronic medical record notes, and the scan was carried out. The effective dose for the unnecessary CT scan was about 27 mSv. Registrars at the hospital were reminded of the importance of checking the electronic medical record.
Incident 8	**A patient had a CT scan unnecessarily repeated due to radiographer error.** A patient presented to a medical imaging practice with a referral for a CT scan of the abdomen and pelvis. The patient was scanned and then sent back to the ward of the hospital to which the practice was attached. The referral was then resent in error from the ward to the imaging practice and the same scan was completed again three days later. The effective dose for the unnecessary CT scan was about 3 mSv. The radiographer was reminded to check for previous imaging prior to performing scans.
Incident 9	**A patient had a CT scan unnecessarily repeated due to radiologist error.** A hospital patient underwent an unnecessarily repeated CT scan of the brain for a neuro-navigation protocol. The scan was requested with contrast but was protocoled incorrectly as a non-contrast scan by the radiologist, who was also protocolling other requests at the time. The requesting department indicated that a contrast brain scan was needed, and the scan was repeated. The effective dose from the first scan was about 2.6 mSv. The radiologist was reminded of the need to take more care during protocolling of multiple requests.
Incident 10	**A patient had a CT scan unnecessarily repeated due to referring physician error.** A hospital patient required a CT scan of the left hip and femur for pre operation planning. The requesting physician only ordered a CT scan of the hip. Following imaging, the orthopaedics registrar called to indicate that a CT scan of the left femur was also required. Imaging of the hip had to be repeated as the hip and femur were required on the same image. The effective dose from the first scan was about 1.6 mSv. The requesting physician was reminded to be vigilant when filling out request forms.
Incident 11	**A paediatric patient had a CT scan unnecessarily repeated due to radiographer error.** A paediatric hospital patient required a CT scan of the chest with contrast. The patient had two 3-way taps inserted instead of the usual one. Only one 3-way tap was confirmed to be open by the two radiographers in attendance. The contrast was administered using the other 3 way tap, which was not clear. Contrast was therefore not administered to the patient as required and the CT scan had to be repeated. The effective dose due to the unnecessary CT scan of the chest was about 0.3 mSv. The radiographers were counselled by the Chief Radiographer.
Incident 12	**A patient had a SPECT-CT scan unnecessarily repeated due to nuclear medicine technologist error.** A patient attended a medical imaging practice for a SPECT CT renal scan. Shortly after the commencement of the renogram, the nuclear medicine technologist inadvertently brushed against the control screen. About eight minutes later, the nuclear medicine technologist noticed that the scan had been paused as a result of this contact with the control screen. The scan had to be repeated. The effective dose from the initial (terminated) scan was about 1.4 mSv. No further action was necessary.

Unnecessarily repeated medical imaging procedures (continued)

Incident no.	Description of incident
Incident 13	**A patient had a CT scan unnecessarily repeated due to radiographer error.** A patient at a medical imaging practice underwent an unnecessarily repeated CT scan of the brain performed using a duplicate referral. The first exam was completed using an electronic version of a paper referral and then the original paper copy was presented for the second presentation. The radiographer involved did not check for previous scans. The effective dose from the repeated scan was about 1.5 mSv. The radiographer was reminded to check for previous imaging prior to performing scans.
Incident 14	**A patient had a CT scan unnecessarily repeated due to radiographer error.** A hospital patient presented to the radiology department for a two-phase CT scan of the cardiac veins. The radiographer selected an incorrect timing delay for the second contrast scan resulting in suboptimal image quality. The two-phase CT scan had to be repeated. The effective dose from the first scan was about 6.6 mSv. The Senior CT Radiographer at the hospital counselled the radiographer involved and reminded them of the importance of reviewing the imaging request and correctly selecting the required timing delays.
Incident 15	**A patient had an unnecessarily repeated PET scan due to extravasation of a radiopharmaceutical.** A patient presented to a hospital for a ^{18}F-FET PET scan. The cannula for the injection of the radiopharmaceutical was tested prior to injection with no report of discomfort by the patient and no resistance to injection of fluid. Most of the radiopharmaceutical extravasated, resulting in scan failure. The effective dose due to the radiopharmaceutical injection was about 4.8 mSv. No other action was necessary.
Incident 16	**A patient had a CT scan unnecessarily repeated due to referring physician and radiographer error.** A hospital patient was referred for a CT scan for a transcatheter aortic valve implantation workup that had already been performed two weeks previously. The referring physician made a request for the scan, without checking for previous scans. The radiographer did not check prior imaging before scanning the patient. The effective dose due to the CT scan was about 13 mSv. The referring physician was reminded to check for previous scans when ordering medical imaging for patients. The radiographer was reminded to check for previous imaging prior to performing scans.
Incident 17	**A patient had a CT scan unnecessarily repeated due to radiographer error.** A hospital patient was brought to the radiology department for a CT scan of the lower right leg from the knee down to the where the leg was amputated. The radiographer saw that the patient's left leg was amputated and assumed that the doctor had requested the scan for the wrong side. The radiographer could not see the right leg, which was also amputated, as it was covered by blankets and bedding. The scan range for the left leg did not include the region of the right leg below the knee and the scan had to be repeated. The effective dose due to the CT scan was about 2.5 mSv. The radiographer was reminded to seek advice in cases of uncertainty.
Incident 18	**A patient had a PET/CT scan unnecessarily repeated due to a power outage.** A patient attended a medical imaging centre for a PET/CT scan. Whilst undergoing the scan, there was an unexpected power outage. The scan had to be repeated when power was restored. The effective dose from the initial (terminated) scan was about 3.1 mSv. No further action was necessary.

Unnecessarily repeated medical imaging procedures (continued)

Incident no.	Description of incident
Incident 19	**A patient had a CT scan unnecessarily repeated due to radiographer error.** A hospital patient had a CT scan for a skeletal survey based on a valid referral. The patient had already had the CT scan two days before from the faxed referral. The effective dose from the scan was about 4.8 mSv. The radiographer was reminded to check for previous scans before imaging a patient.
Incident 20	**A patient had a CT scan unnecessarily repeated due to radiographer error.** A patient at a medical imaging practice had to have a CT scan of the knee repeated because the images were not transferred to the electronic picture archiving and communication system (PACS) by the radiographer. The error was not picked up until the data from the scan had been deleted. The effective dose from the scan was about 2.4 mSv. The radiographer was reminded to ensure that imaging data are immediately transferred to PACS. A notice was attached to the CT scanner to remind radiographers to transfer imaging data to PACS.
Incident 21	**A patient had an unnecessarily repeated CT scan due to extravasation of the contrast medium.** A patient attended a medical imaging practice for a multiphase CT scan of the liver. No contrast was observed on the images as the contrast medium had extravasated. The effective dose from the scan was about 44 mSv. No further action was necessary.
Incident 22	**A patient had an unnecessarily repeated CT scan due to ward staff error.** A patient attended a medical imaging practice for a CT scan of the lumbar spine prior to a nerve root injection. After the CT scan, a nurse checked the patient's drug chart and noticed that the patient had been given an injection of Clexane (an anticoagulant) that morning, even though ward staff had been told to withhold the Clexane. The nerve root injection was abandoned. The effective dose from the unnecessary CT scan was about 1.1 mSv. Ward staff members were reminded to be more vigilant in future.
Incident 23	**A patient had two unnecessarily repeated CT scans.** A hospital patient had two aborted CT brain perfusion scans. The first scan was aborted as the contrast injector was not coupled tightly enough to the patient cannula and the injector disconnected during table movement. The second scan was aborted because the radiographer tried to repeat the perfusion scan without manually recoupling the scanner and injector. The effective dose from the unnecessary CT scans was about 4.6 mSv. The radiographer underwent refresher training in cannulation for CT brain perfusion scans.
Incident 24	**A patient had a PET/CT scan unnecessarily repeated due to a cannulation failure.** A patient attended a medical imaging practice for a ^{18}F-FDG PET nuclear medicine scan. The patient was cannulated and the line was checked and working well prior to injection of tracer. During administration of the ^{18}F-FDG the auto injector displayed an occlusion error and the administration was aborted. The CT scan carried out as a part of this procedure had to be repeated. The effective dose from the CT scan was about 1.7 mSv. No further action was required.
Incident 25	**A patient had a CT scan unnecessarily repeated due to radiographer error.** A hospital patient was scheduled to undergo a CT scan of the brain (circle of Willis) with intravenous contrast. The syringes for the saline and contrast injectors were accidentally swapped by the radiographer. The CT images lacked sufficient contrast enhancement and the scan had to be repeated. The effective dose from the CT scan was about 1.1 mSv. The radiographer was reminded to pay attention to the task at hand when carrying out scans.

Unnecessarily repeated medical imaging procedures (continued)

Incident no.	Description of incident
Incident 26	**A patient had a CT scan unnecessarily repeated due to radiographer error.** A hospital patient had a CT scan of the brain based on a referral entered into the hospital's electronic records system. The written referral was then sent to the ward and the patient had the same scan again as the radiographer did not check for previous imaging. The effective dose from the CT scan was about 1.9 mSv. The radiographer was reminded to check for previous scans before imaging a patient.
Incident 27	**A patient had an unnecessarily repeated CT scan due to extravasation of the contrast medium.** A hospital patient was referred for a CT scan of the chest with contrast. No contrast was observed on the images as the contrast medium had extravasated. The effective dose from the scan was about 3.6 mSv. No further action was necessary.
Incident 28	**A patient had an unnecessarily repeated nuclear medicine scan due to extravasation of a radiopharmaceutical.** A hospital patient was injected with 805 MBq of ^{99m}Tc-HDP for a nuclear medicine bone scan. The intravenous line was patent and working as expected. There was, however, extravasation of the ^{99m}Tc-HDP. The scan had to repeated. The effective dose due to the first injection was less than about 4 mSv. No other action was necessary.
Incident 29	**A patient had a CT scan unnecessarily repeated due to radiographer error.** A hospital patient was scheduled to undergo a CT pulmonary angiogram. The radiographer got distracted and set up the scanner for a CT scan of the chest. The effective dose from the CT scan of the chest was about 1.3 mSv. The radiographer was reminded to pay attention to the task at hand when carrying out scans.
Incident 30	**A patient had a CT scan unnecessarily repeated due to referring physician error.** A patient was referred to a medical imaging practice for a CT scan of the brain and a plain X-ray of the chest. The referring physician requested the scans again, despite realising that the scans had already been ordered at another site. The effective dose due to the scans was about 2 mSv. The referring physician was cautioned not to reorder scans for patients.
Incident 31	**A patient had a CT scan unnecessarily repeated due to radiographer error.** A patient attended a medical imaging practice for a CT topogram. The radiographer did the topogram without altering the previously set scanning range. The scan did not cover sufficient anatomical range and had to be repeated. The effective dose due to the first scan was about 4 mSv. The radiographer was reminded to pay attention to the task at hand when carrying out scans.
Incident 32	**A patient had a radiopharmaceutical injection unnecessarily repeated due to concerns about COVID.** A patient at a medical imaging practice was injected with 835 MBq ^{99m}Tc-HDP for a bone scan. Before the scan could be carried out, the patient developed a cough which classified the patient as a suspected COVID patient and the patient underwent a COVID-19 test. The negative COVID-19 test result did not come through in time to be able to perform the scan. The effective dose due to the radiopharmaceutical injection was about 3.7 mSv. No other action was necessary.

Unnecessarily repeated medical imaging procedures (continued)

Incident no.	Description of incident
Incident 33	**A patient had a CT unnecessarily repeated due to nuclear medicine technologist error.** A hospital patient was scheduled for a PET scan to check for pulmonary nodules. The attenuation correction CT scan was performed without error. Eight minutes into the PET scanner acquisition, however, the scanner shutdown and immediately restarted. The attenuation correction CT data was lost due to the restart. The patient subsequently was required to undergo a second attenuation correction CT. The cause of the shutdown was a cable into the console computer being dislodged by the nuclear medicine technologist. The effective dose due to the CT scan was about 4 mSv. Nuclear medicine technologists were made aware of the problem and were directed routinely to check the connection.
Incident 34	**A paediatric patient had an unnecessarily repeated X-ray due to radiographer error.** A paediatric hospital patient underwent full spine scoliosis X-ray imaging. The patient was imaged without a brace despite the request specifically stating that a brace was required for the imaging. The series of images was repeated with the brace on. The effective dose due to the scan was about 0.5 mSv. The radiographer was reminded of the importance of reviewing the imaging request before scanning.
Incident 35	**A patient had a CT unnecessarily repeated due to contrast injection failure.** A hospital patient underwent a repeated CT pulmonary angiography (CTPA) scan. While undergoing the contrast-enhanced scan, the saline syringe connected to the contrast injector ejected. As the saline flow is required to push the preceding iodinated contrast through the injector to the patient, an inadequate amount of contrast was administered. The effective dose due to the CT scan was about 20 mSv. No other action was necessary.
Incident 36	**A patient had a CT unnecessarily repeated due to radiographer error.** A hospital patient presented with a request for a CT scan of the abdomen and pelvis but was too unwell to be scanned. The patient later presented for a chest X-ray, at which time the patient also had the CT scan. In the time between the CT scan not being performed and the later successful CT scan, the CT scan was cancelled by the requesting doctor. The cancellation was not apparent to the scanning radiographers due to the scan being set to "registered" status within the radiology information system (RIS) during the first scan attempt, which does not allow cancellation of requests under the assumption that the scan is proceeding as planned. The effective dose due to the CT scan was about 20 mSv. Radiographers were reminded to set postponed scans back to "requested" in the RIS. This allows scans to be cancelled.
Incident 37	**A patient had an unnecessarily repeated nuclear medicine scan due to extravasation of a radiopharmaceutical.** A hospital patient was undergoing a cardiac stress test with ^{99m}Tc-MIBI. The rest dose was injected successfully and rest imaging was acquired. During set-up for stress test, however, up to 890 MBq of the radiopharmaceutical extravasated. The effective dose to the patient was about 4.4 mSv. No other action was necessary.
Incident 38	**A patient underwent an unnecessarily repeated CT scan of the brain scan due to radiographer error.** A hospital patient was scheduled for a CT scan of the brain and a carotid angiogram. During the scan, the radiographer noticed that the patient had already had a CT scan of the brain earlier that day. The effective dose due to the CT scan was about 3 mSv. The radiographer was reminded to check for previous imaging prior to performing scans.

Unnecessarily repeated medical imaging procedures (continued)

Incident no.	Description of incident
Incident 39	**A patient underwent an unnecessarily repeated CT brain scan due to radiographer error.** A hospital patient was undergoing a CT study. The initial CT scan was performed in the arm-down position (arm within the scan field of view) when the scan had to be performed in the arm-up position. Another CT scan was therefore performed in the arm-up position. The effective dose from the initial scan was about 3.0 mSv. The radiographer was reminded to pay attention to the task at hand when carrying out scans.
Incident 40	**A patient underwent an unnecessarily repeated CT chest scan due to radiographer error.** The patient presented initially with a faxed request form for a CT scan. About two weeks afterwards the patient booked for the same CT scan using the original paper copy of the referral. The radiographer did not check for previous scans. The effective dose from the scan was about 11 mSv. The radiographer was reminded to check for previous scans prior to imaging patients.
Incident 41	**A patient had an unnecessarily repeated nuclear medicine scan due to extravasation of a radiopharmaceutical.** A hospital patient presented for a nuclear medicine lung ventilation and perfusion scan. The intravenous line was patent and working as expected for injection following adequate saline flush. On injecting the radioactive tracer, however, 178 MBq of ^{99m}Tc macroaggregated albumin extravasated in the right forearm. The effective dose to the patient was about 2.5 mSv. No further action was necessary.
Incident 42	**A patient underwent an unnecessarily repeated CT shoulder scan due to a power failure.** A patient at a medical imaging practice was having a CT scan of the shoulder when a power failure occurred during the reconstruction phase. No data could be recovered when the system was restarted. The effective dose from the scan was about 3 mSv. No further action was necessary.
Incident 43	**A patient underwent an unnecessarily repeated PET/CT scan due to evacuation of hospital staff and patients.** The acquisition of a PET/CT scan at a hospital had to be aborted due to the mandatory evacuation of all staff members and patients in the department when the code red (fire) and code orange (evacuation) alarms sounded. The PET/CT acquisition had to be repeated but re administration of the radiopharmaceutical was not required. The effective dose from the CT scan was about 10 mSv. No further action was necessary.
Incident 44	**A paediatric patient underwent an unnecessarily repeated CT scan of the brain due to medical practitioner error.** A paediatric hospital patient was referred by the emergency department (ED) for a CT scan of the brain and orbits with contrast. The clinical indications on the order were for orbital cellulitis. Due to the lack of indications warranting the CT brain portion of the study, the radiology registrar contacted the ear, nose and throat (ENT) registrar for advice and the procedure was altered to be a CT scan of the orbits and sinuses with contrast. After the imaging was completed, the ED registrar contacted the radiographer to ask why the CT scan of the brain had not been included. The radiographer informed the ED registrar that the radiology registrar had contacted the ENT registrar and deemed that the clinical indications in the order did not warrant the CT scan of the brain. The ED physician indicated that intracranial abnormality was listed in the order; this was not clearly indicated. The patient subsequently had a CT scan of the brain as initially requested. The effective dose from the repeated parts of the scan was about 0.6 mSv. The radiology department sent a communication to all medical practitioners reminding them to ensure that notes on referrals are clear.

Unnecessarily repeated medical imaging procedures (continued)

Incident no.	Description of incident
Incident 45	**A patient had unnecessarily repeated CT scans due to leakage of the contrast medium.** A hospital patient was referred for a CT scan of the abdomen with contrast. The scan was aborted due to contrast leakage. The scan had to be repeated. For the repeat scan, contrast monitoring scans were supposed to take place followed by a time delay (35 seconds) prior to the main scan. The main scan, however, occurred immediately after the monitoring scans. The radiographer aborted the scan again. An appropriate time delay was then introduced and the scan proceeded successfully. The effective dose from the repeated parts of the scan was about 5 mSv. Radiographers at the hospital were reminded to check the technical parameters of scans before scanning.
Incident 46	**A patient underwent an unnecessarily repeated CT scan of the elbow due to radiographer error.** A hospital patient had an unnecessarily repeated CT scan of the right elbow. The original referral for the scan was made three months prior and the booking was made ahead of time. The patient had another referral for the same scan from a different referrer in the interim. The first scan was performed at another campus of the hospital. The radiographer carrying out the second scan did not check for previous imaging. The effective dose from the scan was about 9.5 mSv. The radiographer was reminded to check for previous scans prior to imaging patients.
Incident 47	**A patient had an unnecessarily repeated CT scan due to extravasation of the contrast medium.** A hospital patient underwent a repeated CT pulmonary angiography due to an error during contrast administration. The cannula for the contrast medium was checked for viability by flushing with saline and the scan was carried out. When the patient was scanned, it appeared that contrast had not been correctly administered, resulting in non diagnostic images. The effective dose from the scan was about 5 mSv. No further action was necessary.
Incident 48	**A patient had an unnecessarily repeated CT scan due to extravasation of the contrast medium.** A patient at a medical imaging practice had to have a repeated CT pulmonary angiography due to extravasation of the contrast medium during the first scan. The effective dose from the scan was about 5.4 mSv. No further action was necessary.
Incident 49	**A patient underwent an unnecessarily repeated CT scan of the lumbar spine due to radiographer error.** A patient was booked in for a nuclear medicine scan at a medical imaging practice. The referral also stated that a CT scan of the lumbar spine was required. The CT scan was not booked in on that day. The radiographer included the CT scan as it was not on the electronic imaging storage system of the practice. The radiologist subsequently advised that the scan had been carried out at another campus of the practice the week before. This CT scan had not been transferred to the electronic imaging storage system by the radiographer at that campus. The effective dose from the scan was about 12 mSv. Radiographers at the practice were reminded to ensure all images are transferred to the electronic imaging storage system.
Incident 50	**A patient underwent an unnecessarily repeated CT scan of the abdomen due to incorrect configuration of the detector.** A hospital patient had a CT scan of the abdomen. A streaking artefact was present in the scan due to a calibration error in the configuration of the detector. The CT scan was repeated on another CT scanner. The effective dose from the scan was about 1.7 mSv. The detector configuration was recalibrated and tested with a phantom.

Unnecessarily repeated medical imaging procedures (continued)

Incident no.	Description of incident
Incident 51	**A patient underwent an unnecessarily repeated CT scan of the brain due to incorrect configuration of the detector.** A hospital patient had a CT scan of the brain. A streaking artefact was present in the scan due to a calibration error in the configuration of the detector. The CT scan was repeated on another CT scanner. The effective dose from the scan was about 1.9 mSv. This incident is related to the previous incident and occurred before the reconstruction of the scan in the previous incident revealed an error. The detector configuration was recalibrated and tested with a phantom. This incident involved the same CT scanner as the previous incident and occurred before the detector configuration was fixed.
Incident 52	**A patient underwent an unnecessarily repeated CT scan of the brain due to radiographer error.** A hospital patient had an unnecessarily repeated non-contrast CT scan of the brain. The CT scans were performed using two requests for imaging from different referring practitioners. The initial CT request was still in the system as a pending order when the second request for imaging was submitted by the same referring unit. Two scans were performed as the radiographer performing the second scan did not check for previous imaging. The effective dose from the scan was about 2.6 mSv. The radiographer was reminded to check for previous scans prior to imaging patients.
Incident 53	**A patient had a CT scan unnecessarily repeated due to referring physician and radiographer error.** A hospital patient was referred electronically by an emergency department physician for a CT scan of the brain and chest. The referring physician was unsure about how to check if the referral had gone through and requested the scan again. The radiographer did not check for previous scans. The scan was repeated unnecessarily. The effective dose due to the scan was about 3.4 mSv. The referring physician was re-educated on how to use the electronic ordering system. The radiographer was reminded to check for previous imaging on all patients before proceeding with a scan.
Incident 54	**A patient had an unnecessarily repeated nuclear medicine scan due to leakage of the radiopharmaceutical.** A hospital patient was referred for a cardiac stress test. The patient was cannulated under ultrasound guidance because of difficulties finding veins. The first dose was injected successfully. For the second dose, the radiopharmaceutical extravasated. The cannula dislodged between the two parts of the scan. The patient needed to return at another time to repeat the scan. The effective dose from the scan was about 8.3 mSv. No further action was necessary.
Incident 55	**A patient underwent an unnecessarily repeated CT scan of the liver due to radiographer error.** A hospital patient presented to the radiology department for a four phase CT scan of the liver. The radiographer set an incorrect anatomical scan range resulting in missed anatomy. Three phases of the liver scan had to be repeated at a later date. The effective dose from the repeated scan was about 5.1 mSv. The Senior CT Radiographer counselled the radiographer and reminded them of the importance of setting the correct anatomical scan range.
Incident 56	**A patient had a CT scan unnecessarily repeated due to referring physician error.** A hospital patient required a non-contrast CT scan of the brain 24 hours after a bleed. An emergency department physician referred the patient for a scan seven hours post bleed and the scan had to be repeated at 24 hours. The effective dose from the scan was about 1.2 mSv. The physician was reminded to consult with a neurologist concerning timing of scans.

Unnecessarily repeated medical imaging procedures (continued)

Incident no.	Description of incident
Incident 57	**A patient had a CT scan unnecessarily repeated due to a scanner not picking up an electroencephalogram (ECG) trace.** A hospital patient had a CT aortogram with contrast but the scanner didn't pick up a clear (ECG) trace and repeated the gated scan. The effective dose from the scan was about 4.4 mSv. A service technician from the supplier changed hardware in the ECG equipment to enable better detection of the ECG trace.
Incident 58	**A patient had an unnecessarily repeated nuclear medicine scan due to extravasation of the radiopharmaceutical.** A hospital patient was having a cardiac stress test SPECT/CT scan. Extravasation of the 310 MBq ^{99m}Tc-MIBI injected was identified 30 minutes after the administration of the radiopharmaceutical. The SPECT/CT scan was attempted but the acquired images non diagnostic. The scan had to be repeated. The effective dose from the scan was about 3.4 mSv. No further action was necessary.
Incident 59	**A patient underwent an unnecessarily repeated CT scan of the kidneys, ureters and bladder due to radiographer error.** A patient attended a medical imaging practice for a CT scan of the kidneys, ureters and bladder. The patient was in the prone position but was supposed to be in the supine position. The radiographer did not check the patient's position. The scan orientation was wrong and this was not able to be corrected for on the CT scanner used. A repeat scan was required. The effective dose from the scan was about 7.2 mSv. The radiographer was spoken to regarding the importance in checking the patient position before scanning.
Incident 60	**A patient had an unnecessarily repeated CT scan due to extravasation of the contrast medium.** A patient attended a medical imaging practice for a CT coronary angiogram (CTCA). A second CTCA scan had to be carried out when the contrast extravasated during the first scan. The effective dose from the scan was about 7.4 mSv. No further action was necessary.
Incident 61	**A patient had a PET/CT scan unnecessarily repeated due to a power outage.** A patient attended a medical imaging practice for a PET/CT scan. There was a power outage during the CT scan and no patient data were able to be recovered. The scan had to be repeated. The effective dose from the scan was about 3.1 mSv. No further action was necessary.
Incident 62	**A patient had an unnecessarily repeated injection of radiopharmaceutical due to extravasation.** A hospital patient was injected with 669 MBq ^{99m}Tc-MDP for a bone scan. One minute after the injection was started no blood flow could be observed in the dynamic images as the radiopharmaceutical had extravasated. Another smaller dose was given to the patient to complete the study. The effective dose due to the radiopharmaceutical injection was about 2.7 mSv. No further action was necessary.

Unnecessarily repeated medical imaging procedures (continued)

Incident no.	Description of incident
Incident 63	**A patient had an unnecessarily repeated injection of radiopharmaceutical due to extravasation.** A hospital patient was having a nuclear medicine scan and was successfully cannulated for injection of saline prior to injection of 795 MBq ^{99m}Tc-HDP. On injection of the HDP, the patient experienced pain. When the patient was imaged, a reduced target tissue count rate was noted. The injection site was imaged and this confirmed extravasation. The effective dose due to the radiopharmaceutical injection was about 3.9 mSv. No further action was necessary.
Incident 64	**A patient underwent an unnecessarily repeated CT scan of the kidneys, ureters and bladder due to radiographer error.** A hospital patient was referred for a CT scan of the kidneys, ureters and bladder. The patient presented again for the same scan because of correct procedure not being followed during patient handover. The radiographer did not check for previous scans. The effective dose from the scan was about 6 mSv. The radiographer was reminded to check for previous imaging prior to performing scans.
Incident 65	**A paediatric patient underwent an unnecessarily repeated chest X-ray due to radiographer error.** A paediatric patient attended a medical imaging practice for a chest X-ray. The referral was faxed through to the practice and entered into the electronic ordering system. The scan was performed upon receipt of the faxed referral. A radiographer then carried out the same procedure using the electronic referral without checking for previous imaging. The effective dose from the scan was about 0.013 mSv. The radiographer was reminded to check for previous imaging prior to performing scans.
Incident 66	**A patient had an unnecessarily repeated injection of radiopharmaceutical due to extravasation.** A patient presented to a hospital for a nuclear medicine renal scan using ^{99m}Tc. The patient was cannulated and then the injection was started. After the injection started a portion of the ^{99m}Tc extravasated into the arm. A second top-up dose of 300 MBq was administered to compensate for the amount lost due to extravasation. The effective dose due to the extra radiopharmaceutical injection was about 2.1 mSv. No further action was necessary.
Incident 67	**A patient had an unnecessarily repeated administration of a radiopharmaceutical due to poor labelling of the pharmaceutical.** A hospital patient was referred for a gastrointestinal bleed study. The patient's blood was labelled with 15 GBq ^{99m}Tc-pertechnetate using a labelling product. The blood labelled with pertechnetate was injected back into the patient and the patient was scanned. On review of the images, it was determined that the scan was non-diagnostic due to poor labelling efficiency. The effective dose due to the administration of the radiopharmaceutical was about 14 mSv. The hospital removed that batch of the product and switched to an alternative product.
Incident 68	**A paediatric patient had an unnecessarily repeated administration of a radiopharmaceutical due to a problem with the pharmaceutical.** A paediatric hospital patient had to have a nuclear medicine renal scan with 78 MBq ^{99m}Tc-DMSA repeated due to an unknown issue with the radiopharmaceutical. The ^{99m}Tc-DMSA was administered to the patient after passing all internal quality control checks. When the patient was imaged the distribution of the radiopharmaceutical was whole body rather than being localised to the renal cortex, as required. The scan was repeated successfully with another radiopharmaceutical kit five days later. The effective dose due to the administration of the radiopharmaceutical was about 1.5 mSv. The incident was discussed with the company and radiopharmacist who manufactured the kit. No other issues were reported to the company for that batch of kits.

Unnecessarily repeated medical imaging procedures (continued)

Incident no.	Description of incident
Incident 69	**A patient had a PET/CT scan unnecessarily repeated due to a power outage.** A patient at a medical imaging practice was having a whole-body PET/CT scan (top of the head to feet). During the CT part of the scan, the practice experienced a power outage and only images from the patient's knees to feet were acquired. The patient had the CT part of the scan repeated. The effective dose from the repeated part of the CT scan was about 3 mSv. No further action was necessary.
Incident 70	**A patient underwent an unnecessarily repeated CT scan of the chest, abdomen and pelvis due to radiographer error.** A patient at a medical imaging practice had an unnecessarily repeated CT scan of the chest, abdomen and pelvis. The patient had brought the same referral as for the first scan. The patient mentioned having had a CT scan the day before but was not sure what type of scan. There was nothing in the patient's file that indicated what scan had been carried out. The radiographer did not check for previous imaging. The effective dose from the scan was about 14 mSv. The radiographer was reminded to check for previous imaging prior to scanning.
Incident 71	**A patient underwent an unnecessarily repeated CT scan of the abdominal aorta due to X-ray tube heating.** A hospital patient was referred for a CT scan of the abdominal aorta. After the planning views were acquired the CT scanner indicated a delay time of five minutes was required before further scanning could be carried out due to the projected X-ray tube heating. After a delay time of less than five minutes, the monitoring scans were started. After the monitoring scans and injection of contrast a further delay of two minutes was indicated due to X-ray tube heating. Due to the timing requirements of the contrast enhancement, this required repetition of the entire scan. The tube overheating was exacerbated by the large patient habitus. Waiting for the full five minutes of the overheating timer to elapse, allowing the tube to cool sufficiently, would have avoided the scan being aborted. Exposure factors could also have been reduced to limit tube overheating. The effective dose from the scan was about 1.3 mSv. Radiographers were reminded to wait for the full five minutes of the overheating timer to elapse and to use lower exposure factors, when possible, when tube overheating is likely to occur.
Incident 72	**A patient underwent an unnecessarily repeated CT scan of the brain due to use of the wrong contrast injection equipment.** A hospital patient was referred for a CT scan of the brain with contrast but the scan was performed without contrast due to use of the wrong contrast injection equipment. Prior to the scan, this CT scanner and one in an adjacent room both required isolation cleaning and, during this time, the contrast injectors from the rooms were swapped. As the contrast injectors communicate wirelessly with their own respective control panels, the command to use contrast was given to the wrong injector. The effective dose from the scan was about 1.2 mSv. Radiographer training was increased for these injectors and the injectors were more conspicuously labelled to make their correct locations readily apparent.
Incident 73	**A patient underwent an unnecessarily repeated CT scan of the brain due to radiographer error.** A patient attended a medical imaging practice for a CT scan of the brain after making an online appointment. The patient had an unclear referral and advised the reception staff member that a CT scan of the brain was required and the scan was booked in as a CT scan of the brain. The radiographer did not check for previous scans. The reporting radiologist noted that the referral was for an MRI scan instead of a CT scan and that the CT scan had been carried out 10 days before. The effective dose from the scan was about 2.6 mSv. Radiographers at the practice were reminded to carry out patient and procedure processes thoroughly and always to check for previous images.

Unnecessarily repeated medical imaging procedures (continued)

Incident no.	Description of incident
Incident 74	**A patient underwent an unnecessarily repeated pre joint replacement CT scan due to radiographer error.** A patient attended a medical imaging practice for a pre joint replacement CT scan of the knee. The patient was scanned but no images were sent to the picture archiving and communication system (PACS). The patient had to be rescanned as the original images were deleted from the CT scanner when its memory was full. Orthopaedic pre joint replacement scans have very specific reconstruction rules that are unable to be set reliably prior to scanning. Radiographers at the practice were aware of this problem and knew that reconstructions had to be performed immediately after such a scan. The radiographer did not perform the reconstructions immediately after the scan and did not check PACS to ensure that the images were available. The effective dose from the scan was about 3.8 mSv. The radiographer was spoken to regarding the importance of performing the reconstructions immediately after pre joint replacement scans.
Incident 75	**A patient had a CT scan unnecessarily repeated due to a power surge.** A patient attended a medical imaging practice for a CT scan of the chest, abdomen and pelvis with contrast. A power surge occurred straight after the arterial phase of the chest scan and the scanner stopped working. The initial arterial data set was corrupted so the radiologist authorised a full rescan. The chest region was scanned twice. The effective dose from the repeated CT scan of the chest was about 5.4 mSv. No further action was necessary.
Incident 76	**A patient underwent an unnecessarily repeated CT angiogram due to radiographer error.** A hospital patient was referred for a CT angiogram from the diaphragm to mid-thigh. The imaging was performed by one radiographer. At the conclusion of the final acquisition, a second radiographer marked the examination as complete on the radiology information system (RIS) and attempted to send the required images to the picture archiving and communication system (PACS). Neither radiographer sighted the images on PACS. Only the radiation dose structured report had been sent to PACS as the manufacturer's website was down at the time due to a hardware fault. The effective dose from the scan was about 9.8 mSv. The radiographers were reminded to check that all images are transferred to PACS after scanning.
Incident 77	**A patient underwent an unnecessarily repeated CT scan due to radiographer error.** A hospital patient was referred for a CT scan of the chest, abdomen and pelvis. The radiographer set the scan ranges for the arterial phase of the chest and portal venous phase of the abdomen and pelvis incorrectly, which resulted in the arterial phase scan covering the abdomen and pelvis as well as the chest. The effective dose from the scan of the abdomen and pelvis was about 5.7 mSv. The Chief Radiographer reminded the radiographer of the importance of setting scan ranges correctly.

Unnecessary, unrequested or unapproved medical procedures

Incident no.	Description of incident
Incident 78	**A patient had an unnecessary CT scan due to radiographer and radiology registrar error.** A hospital patient required a CT adrenal scan to be performed one year following the request date. Imaging was justified by a radiographer and scheduled for one week after the request date. The scanning radiographer consulted a radiology registrar to query the time of the scan. The registrar advised the scanning radiographer to proceed with the imaging. The reporting radiologist, after reviewing prior imaging, advised that the contrast portion of the scan should not have been carried out. The patient received an unnecessary CT scan. The effective dose due to this unnecessary procedure was about 13 mSv. The radiographer who initially justified the procedure was counselled regarding the importance of consulting the requested imaging date on scheduled exams. The radiology registrar was counselled concerning the importance of clarifying the required examination with the treating team and the importance of checking prior imaging.
Incident 79	**A patient underwent an unnecessary CT scan of the chest due to radiographer error.** A hospital patient required a CT colonography with a protocolled abdomen-pelvis scan range. The radiographer chose the chest abdomen scan range. The chest was scanned unnecessarily. The effective dose due to this unnecessary procedure was about 4.7 mSv. The radiographer was counselled by their supervisor.
Incident 80	**A patient had an unnecessary CT scan due to radiographer error.** A patient presented to a medical imaging practice for an "X-ray C/T spine" (plain X-ray scan of the cervical/thoracic spine). The radiographer mistakenly interpreted the "C/T spine" as being a request for a CT scan of the cervical spine and the patient had a CT scan of the cervical spine. The radiographer failed to follow the correct pre-examination protocol. The effective dose due to this unnecessary procedure was about 1.5 mSv. The radiographer was reminded to use the practice's pre examination protocol.
Incident 81	**A patient had an unnecessary CT scan due to radiographer error.** A hospital patient had a CT scan of the brain and was required to have a follow up CT brain scan 24 hours after the first scan. The patient, however, had the CT scan five hours after the first scan because the radiographer did not check the referral thoroughly and did not check the hospital's electronic records system for previous imaging. The effective dose due to the scan was about 1.7 mSv. The radiographer was reminded thoroughly to review the referral and check for previous imaging.
Incident 82	**A patient had an unnecessary CT scan of the chest due to radiographer error.** A patient presented to a hospital with a request for a CT scan of the abdomen and pelvis but underwent a CT scan of the chest, abdomen and pelvis (CAP) scan. The radiographer had just performed four consecutive CAP scans and made an error in reading the imaging request form. The effective dose due to the CT scan of the chest was about 5.5 mSv. The radiographer was counselled and reminded of the importance of careful reading each request form.
Incident 83	**A patient had an unnecessary CT scan due to requesting physician error.** A hospital patient had an unnecessary CT cervical spine scan. The patient was protocolled according to the request for a non-contrast brain scan and cervical spine scan. After the scan was performed, the requesting physician advised that the patient also needed a carotid angiogram. As this scan required contrast, reformatting of the existing scans was not possible and the patient was rescanned over the same anatomical region. The effective dose from the first scan was about 6 mSv. The protocolling radiologist informed the requesting physician to list all imaging required in the one request.

Unnecessary, unrequested or unapproved medical procedures (continued)

Incident no.	Description of incident
Incident 84	**A patient had an unnecessary CT scan of the chest due to radiographer error.** A patient presented to a hospital with a request for a CT scan of the chest. The radiographer selected the wrong CT chest protocol and the scan had to be repeated using the correct protocol. The effective dose due to the first CT scan was about 1.2 mSv. The radiographer was reminded of the importance of carefully reading each request form.
Incident 85	**A patient had an unnecessary CT scan due to requesting physician error.** A CT scan of the lumbar spine was electronically ordered for a patient by a physician. The scan was carried out and then the physician informed the radiographer that they meant to order an MRI of the lumbar spine and had selected a CT scan by mistake. The effective dose due to the CT scan was about 5.2 mSv. The physician was reminded to be careful when placing orders for scans.
Incident 86	**A patient had an unnecessary CT scan due to radiographer error.** An ultrasound guided shoulder steroid injection was ordered for a patient at a medical imaging practice. The radiographer failed to carry out the procedure identification process and performed a CT guided shoulder steroid injection instead. The effective dose due to the CT guided shoulder steroid injection was about 2.3 mSv. All staff at the practice were reminded of the importance of thoroughly carrying out the patient and procedure identification processes.
Incident 87	**A paediatric patient had an unnecessary DXA scan due to radiographer error.** A paediatric patient attended a medical imaging practice for a dual-energy X-ray absorptiometry (DXA) scan. The scan was carried out but the machine at the practice did not have a paediatric protocol so the data were incomplete and couldn't be used. The patient was referred to another practice that had a paediatric protocol on its DXA scanner. The effective dose due to the DXA scan was about 0.025 mSv. The radiographer was reminded that paediatric DXA scans were not to be carried out on that scanner.
Incident 88	**A patient had a part of the body unnecessarily scanned due to radiographer error.** A hospital patient was referred for a CT multi-phase kidney scan. The CT arterial phase scan range was set to extend down to the pubic symphysis when it should only have extended to cover the kidneys. The error occurred because the radiographer was unfamiliar with the type of CT scanner being used. The effective dose due to the extra part of the body scanned was about 1.2 mSv. The radiographer was given training on the use of the CT scanner.
Incident 89	**A patient had a part of the body unnecessarily scanned due to radiographer error.** A hospital patient presented for a CT scan of the cervical spine, chest, abdomen and pelvis following a motor vehicle accident. The radiographer incorrectly selected the brain and cervical spine protocol instead of the cervical spine protocol. The effective dose due to the CT scan of the brain was about 1.8 mSv. The radiographer was reminded of the importance of reviewing imaging requests and selecting the correct scan protocol.
Incident 90	**A patient had an unnecessary CT scan due to radiographer and radiologist error.** A hospital patient presented for imaging with a request for a low-dose non-contrast CT scan of the chest. On arrival at the radiology department, the patient handed over an additional referral which cited COPD (chronic obstructive pulmonary disease). The radiographer escalated the case to the radiology registrar for justification and approval of a high-resolution CT (HRCT) scan for the COPD indication. Following the HRCT scan it was realised that the second referral was not an imaging referral but a referral to see a respiratory specialist. The effective dose due to the HRCT scan was about 11 mSv. Radiology staff at the hospital were counselled to read referrals thoroughly.

Unnecessary, unrequested or unapproved medical procedures (continued)

Incident no.	Description of incident
Incident 91	**A patient had an unnecessary CT scan due to radiographer error.** A patient presented to a medical imaging practice with a referral for a CT scan of the cervical and lumbar spine and a plain X-ray of the thoracic spine. The radiographer mis-read the referral and performed a CT scan of the thoracic spine rather than a plain X-ray. The effective dose due to the CT scan of the thoracic spine scan was about 6 mSv. The radiographer was reminded to be vigilant when carrying out patient and procedure identification processes.
Incident 92	**A patient had an unnecessary CT scan due to radiographer and clerical staff error.** A hospital patient had a non-contrast CT scan of the abdomen that had been requested to be performed in 12 months' time. Radiology clerical staff booked the scan on the wrong date and the radiographer did not consult the referral. The effective dose due to the CT scan was about 3.8 mSv. Clerical staff members were reminded to exercise care when entering patient and procedure details on imaging requests. The radiographer was reminded to check all pertinent patient information before carrying out imaging procedures.
Incident 93	**A patient had an unnecessary fluoroscopy scan due to radiographer error.** A hospital patient had an unnecessary fluoroscopic X-ray scan. The radiographer accidentally selected the wrong imaging protocol and the scan had to be repeated using the correct protocol. The effective dose due to the scan was about 3.5 mSv. The radiographer was reminded to be careful when entering parameters into scanners prior to examinations.
Incident 94	**A patient had an unnecessary CT scan due to radiographer and referring physician error.** A patient had a CT scan of the brain at a medical imaging practice. On receiving the images, the referring physician indicated that the scan was required one month later (November) to coincide with a specialist appointment. The only indication on the referral specifying that the scan was for November was "Nov" written on the referral. The radiographer did not clarify the date with the referring physician. The effective dose due to the scan was about 2.3 mSv. The referring physician was reminded to give clear written instructions when ordering medical imaging for patients. The radiographer was reminded to seek advice in cases of uncertainty.
Incident 95	**A patient had an unnecessary CT scan due to clerical staff error.** A patient attended a medical imaging practice for a CT scan of the brain and a CT scan of the chest, abdomen and pelvis. The referring physician phoned reception and said that the CT scan of the brain and chest were not needed. A clerical staff member changed the referral and scanned the new referral into the practice's electronic ordering system but did not inform the radiographer. The effective dose due to the brain and chest scan was about 11 mSv. The radiation safety officer for the practice spoke to the clerical staff member and reminded them to inform the radiographer immediately if there is a change to a requested scan.
Incident 96	**A patient had an unnecessary CT scan due to radiographer error.** A patient attended a medical imaging practice for a CT scan of the abdomen and pelvis. The chest was also accidentally included in the scan. The radiographer did not read the referral correctly and scanned the extra area. The effective dose due to the chest scan was about 2 mSv. The radiographer was reminded to be vigilant when carrying out patient and procedure identification processes.
Incident 97	**A paediatric patient had an unnecessary panoramic dental radiograph due to radiographer error.** A paediatric patient attended a medical imaging practice for a plain X-ray of the thumb. The radiographer did not read the referral correctly and carried out a panoramic dental radiograph instead. The effective dose due to the panoramic dental radiograph was about 0.01 mSv. The radiographer was reminded to read referrals carefully.

Unnecessary, unrequested or unapproved medical procedures (continued)

Incident no.	Description of incident
Incident 98	**A patient had an unnecessary CT scan due to radiographer error.** A patient attended a medical imaging practice for a CT scan of the abdomen and pelvis. The radiographer completed the initial localisation scans and then became distracted for a few minutes. Upon restarting the examination, the radiographer inadvertently scanned the chest of the patient rather than the abdomen and pelvis. The effective dose due to the CT scan of the chest was about 4.4 mSv. The radiographer was reminded to concentrate on the task at hand when carrying out medical imaging.
Incident 99	**A patient had an unnecessary CT scan due to radiographer error.** A hospital patient presented for a CT scan of the pelvis but had a CT scan of the abdomen and pelvis. The radiographer did not read the referral correctly. The effective dose due to the CT scan of the abdomen was about 7 mSv. The radiographer was reminded to read referrals carefully.
Incident 100	**A patient had unnecessary exposure of breast tissue due to hospital staff error.** A hospital patient had a 1.24 MBq ^{125}I seed implanted at the anterolateral margin of a breast tumour site to prepare for surgery. The ^{125}I seed implantation service at the hospital had been paused for a few days and Magseed (a marker commonly used for localising impalpable breast lesions) was being used in its place until the ^{125}I seed implantation service resumed. The physician who conducted the surgery was unaware that the ^{125}I seed had been implanted and assumed they were still using Magseed for localisation. The physician had read the radiology report but had missed the heading where it was stated that the ^{125}I seed had been inserted. The Magseed detector was used but could not locate the Magseed. The physician excised the tumour without using the localisation seed. The excised specimen was imaged in a cabinet Xray unit, and a coil clip was located but not the seed. The physician reviewed the patient imaging, which indicated the seed was anterolateral from the clip, so further lateral margin was excised. X-ray imaging did not show the seed in the further excised tissue. After contacting the Magseed supplier, it was determined that the seed implanted may not have been a Magseed. Consultation with the imaging department confirmed that a ^{125}I seed had been implanted. As the ^{125}I seed was not found in the X-ray images of the excised tissue, the surgery used for the operation was sealed off and a radiation survey was carried out but the seed was not found. The patient was also recalled immediately and was found still to have the ^{125}I seed inserted. The seed was removed from the patient. The patient's breast tissue received an unnecessary dose of about 2.7 mGy. Staff involved were counselled by the Radiation Safety Officer and supervisors concerning the factors contributing to the incident. Patients were now to be instructed to bring the card indicating that they had a radioactive seed inserted with them on the day of surgery and to present the card at admission.
Incident 101	**A patient had an unnecessary CT scan due to radiographer error.** A patient presented to a medical imaging practice for a CT scan of the abdomen and pelvis with the note "breast cancer" on the referral. The radiographer misread the note as "brain cancer" and carried out a CT scan of the brain as well. The effective dose due to the CT scan of the brain was about 1.4 mSv. The radiographer was reminded to perform patient and procedure identification processes thoroughly.

Unnecessary, unrequested or unapproved medical procedures (continued)

Incident no.	Description of incident
Incident 102	**A patient had an unnecessary CT scan due to referring physician error.** A patient at a medical image practice had an unnecessary CT scan of the abdomen. The referring physician in the emergency department (ED) of the hospital to which the practice was attached had decided that an ultrasound scan would suffice. The referring physician cancelled the electronic request for the CT scan in the ED system but didn't realise that this didn't cancel the order in the radiology system. The CT scan of the abdomen was carried out. The effective dose due to the CT scan was about 8 mSv. The referring physician was reminded of the need to communicate with the radiographer in the ED for all CT scans they refer and to communicate any changes in the scans required directly to the radiology practice.
Incident 103	**A paediatric patient had an unnecessary X-ray due to radiographer error.** A paediatric patient attended a medical imaging practice for a panoramic dental radiograph. The radiographer did not read the referral correctly and performed an additional lateral cephalic X-ray, which was not requested by the referring physician. The effective dose due to the lateral cephalic X-ray scan was about 0.015 mSv. Radiographers at the practice were reminded thoroughly to consult the referral prior to imaging a patient.
Incident 104	**A paediatric patient had an unnecessary X-ray due to clerical and radiographer error.** A paediatric hospital patient underwent an X-ray of the pelvis about five months before the requested date. The patient had an ultrasound scan with an order for a follow up X-ray in about six months' time. Clerical staff booked the patient for the X-ray one month after the ultrasound scan and the patient had the X-ray at that time. The radiographer did not read the referral. The effective dose for the X-ray was about 0.01 mSv. Clerical staff were reminded to check referrals before booking scans. Radiographers were reminded to check referrals before imaging.
Incident 105	**A patient had an unnecessary CT scan due to radiographer error.** A patient at a medical imaging practice was referred for a CT scan of the brain following a traumatic incident. The scan was requested by the emergency department of the hospital to which the practice was attached. The radiographer who carried out the scan deemed that a CT scan of the brain, cervical spine, abdomen and pelvis was needed by the emergency department, given the nature of the trauma. After the scan, the referring physician stated that only the brain scan was required. The radiographer did not read the referral before carrying out the scan. The effective dose due to the CT scan was about 21 mSv. The radiographer was reminded to carry out the practice's patient and procedure identification process
Incident 106	**A patient had an unnecessary nuclear medicine bone scan due to an error in the referral.** A hospital patient presented to the medical imaging department with a referral that had clinical indications indicating a dual energy CT scan would be required but requested a nuclear medicine bone scan, causing confusion as to which scan was being requested. The referral was reviewed by a nuclear medicine physician who tried to contact the referring physician for clarification. The referring physician could not be contacted and the nuclear medicine physician made the decision to proceed with the injection of 793 MBq of ^{99m}Tc-HDP for the bone scan. Midway through the patient's scan, the referring physician called the medical imaging department and confirmed that the scan was meant to be a dual energy CT scan. The bone scan was completed as the ^{99m}Tc had already been injected. The effective dose due to the bone scan was about 3.9 mSv. New systems were introduced in the hospital to ensure double checking and confirmation of referral details in both the medical and medical imaging departments. Audits were also implemented to detect errors on referral forms.

Unnecessary, unrequested or unapproved medical procedures (continued)

Incident no.	Description of incident
Incident 107	**A patient had an unnecessary CT scan due to referring physician error.** A hospital patient had a referral for cardiac CT scan. After the scan, the radiographer contacted the referring physician to discuss a medical problem that had arisen with the patient. The referring physician indicated that the scan was to be cancelled and that the scan had already been cancelled on the electronic ordering system. It is not possible, however, to cancel a study on the system once it has been scheduled. The medical imaging department must be contacted to cancel a procedure scheduled on the system. The cardiac CT scan order, therefore, was not cancelled and the scan was carried out. The effective dose due to the scan was about 2.9 mSv. The referring physician was informed of the correct cancellation procedure when imaging has been scheduled on the electronic ordering system.
Incident 108	**A patient had an unnecessary CT coronary angiogram due to clerical and radiographer error.** A patient attended a medical imaging practice and was booked in for a CT coronary angiogram and a CT coronary calcium score. The referral was only for a CT coronary calcium score to be carried out. The radiographer did not read the referral before imaging and carried out both procedures. The effective dose due to the CT coronary angiogram was about 2.3 mSv. Clerical staff were reminded to check referrals before booking scans. The radiographer was reminded to carry out the practice's patient and procedure identification process.
Incident 109	**A patient had an unnecessary CT scan of the lumbar vertebrae due to radiographer error.** A hospital patient was referred for a CT scan of the thoracic spine. Given the clinical indications, the radiologist justified and approved the scan of the eighth to twelfth thoracic vertebrae (T8-T12 range). The radiographer counted up from the lumbar spine to determine the T8-T12 range. The radiographer counted the number of vertebrae incorrectly and, as a result, the scanned range also included the first four lumbar vertebrae. The effective dose due to the CT scan of the lumbar vertebrae was about 5.8 mSv. The radiographer was counselled by the Chief Radiographer and CT supervisor regarding the incident. The CT supervisor stressed the need to be attentive whilst carrying out a scan.
Incident 110	**A patient had an unnecessary CT scan of the brain due to medical practitioner error.** A hospital patient required a CT scan of the brain prior to neurosurgery. After the scan, it was noticed that the fiducial markers were not placed in the correct location by the neurosurgeon and the required information could not be obtained from the images. The CT scan had to be repeated. The effective dose due to the scan was about 1.8 mSv. The neurosurgeon was given further education on the placement of fiducial markers for CT scans prior to neurosurgery.
Incident 111	**A patient had an unnecessary CT scan of the chest due to radiographer error.** A hospital patient was referred for a CT scan of the abdomen and pelvis. A clerical staff member scheduled the examination in error as a CT scan of the chest, abdomen and pelvis. The radiologist correctly justified the examination as a CT scan of the abdomen and pelvis due to lack of clinical indications warranting the chest to be scanned. The radiologist noted the required scan range in the justification tab on the electronic ordering system. The radiographer did not check the justification tab prior to imaging and carried out a scan of the chest, abdomen and pelvis. The effective dose due to the chest scan was about 4.4 mSv. Radiographers were reminded to check the justification tab prior to imaging.
Incident 112	**A patient had an unnecessary CT scan due to nuclear medicine technologist error.** A patient attended a medical imaging practice for a PET/CT scan. The infuser pump was loaded with 173.99 MBq ^{18}F-FDG but the nuclear medicine technologist had not inserted the syringe in the patient. The radiopharmaceutical spilled on to a flat surface of the injector stand. This was not noticed by the technologist. The failure to insert the syringe was noticed, after the CT scan, when a staff member went to disconnect the patient from the injector pump and saw that the syringe was not in the patient. The effective dose due to the chest scan was about 3 mSv. No staff member received a dose greater than 1 mSv. Nuclear medicine technologists were reminded to ensure that connections are double checked and injections are working correctly.

Wrong patient underwent a medical procedure

Incident no.	Description of incident
Incident 113	**A patient underwent a CT scan intended for another patient due to referring physician error.** A hospital patient was referred for a CT scan of the brain. During a review within the emergency department the following day, it was noted that the wrong patient had been referred for imaging. The error was made by the referring physician. The effective dose due to the scan was about 1.7 mSv. The referring physician was reminded to be careful when placing patients' names on referrals.
Incident 114	**A patient underwent a CT scan intended for another patient due to referring physician error.** A hospital patient was referred for a CT scan of the chest. The chest scan was carried out on the wrong patient because the referring physician entered the wrong patient details on the request. The error was identified after the incorrect patient had the scan completed. The effective dose due to the scan was about 4.9 mSv. The referring physician was reminded to be careful when placing patients' names on referrals.
Incident 115	**A patient underwent a nuclear medicine scan intended for another patient due to nuclear medicine physician error.** A hospital patient was referred by an emergency department physician for a ^{99m}Tc bone scan. A nuclear medicine physician completed a request slip for a patient with a similar history to that of the intended patient and the scan was completed on the wrong patient. The effective dose due to the scan was about 3 mSv. The nuclear medicine physician was reminded to be careful when placing patients' names on requests.
Incident 116	**A patient underwent a CT scan intended for another patient due to referring physician error.** A hospital patient was referred to a medical imaging practice for a CT scan of the chest, abdomen and pelvis (CTCAP). The CTCAP was performed without event. However, not long after the scan was performed the hospital ward informed practice staff that the incorrect patient had been placed on the referral. The effective dose due to the scan was about 6.7 mSv. The referring physician was reminded to be careful when placing patients' names on referrals.
Incident 117	**A patient underwent a CT scan intended for another patient due to referring physician error.** A hospital patient underwent a CT scan of the soft tissues of the neck intended for another patient. The referring practitioner had placed the wrong patient sticker on the referral slip. Patient identification and procedure matching processes were not carried out properly by the radiographer involved. The effective dose due to the scan was about 1.5 mSv. The referring physician was reminded to be careful when placing patients' names on referrals. The radiographer was reminded to carry out patient and procedure identification processes thoroughly.
Incident 118	**A patient underwent a CT scan intended for another patient due to referring physician error.** A hospital patient presented to the medical imaging department with a referral for a CT scan of the chest, ordered by a cardiothoracic resident. The radiographer checked patient and procedure details and carried out the scan. The cardiothoracic resident later called the reporting radiologist and informed them that the scan had been ordered on the wrong patient. The effective dose due to the scan was about 8 mSv. The referring physician was reminded to be careful when placing patients' names on referrals.
Incident 119	**A patient underwent X-rays intended for another patient due to radiographer error.** A patient at a medical imaging practice had X-rays of the lumbar spine and pelvis that were intended for another patient. The radiographer mistook one patient for another and did not carry out the practice's patient identification process correctly. The radiographer asked closed questions to which the patient simply answered in the affirmative. The effective dose due to the X-rays was about 1.1 mSv. The radiographer was reminded to carry out the practice's patient and procedure identification processes.

Wrong patient underwent a medical procedure (continued)

Incident no.	Description of incident
Incident 120	**A patient underwent a CT scan intended for another patient due to radiographer error.** A patient at a medical imaging practice had a CT scan of the brain that was intended for another patient. One patient answered to a different patient's name and the patient identification and procedure checking process was not carried out correctly by the radiographer. The effective dose due to the scan was about 1.6 mSv. All clinical staff members at the practice were re-briefed on the correct patient identification and procedure checking processes.
Incident 121	**A patient underwent a CT scan intended for another patient due to radiographer error.** A patient at a medical imaging practice had a CT scan of the abdomen that was intended for another patient. One patient answered when their first name was called. The intended patient had the same first name. The patient identification and procedure checking process was not performed correctly by the radiographer. The effective dose due to the scan was about 4.7 mSv. The radiographer has been reminded to carry out the practice's patient identification and procedure checking processes.
Incident 122	**A patient underwent CT scans intended for another patient due to radiographer error.** A patient attended a medical imaging practice for a CT scan of the kidneys. The radiologist advised the radiographer that this "kidney patient" would need to come back for arterial and portal-venous phase CT scans. The radiographer had just been discussing an intravenous pyelogram for another patient with the radiologist and so felt that the radiologist was referring to that patient. The wrong patient had the arterial and portal-venous phase CT scans. The effective dose due to the scans was about 23 mSv. The radiographer was reminded to carry out the practice's patient and procedure identification processes.
Incident 123	**A patient underwent a CT scan intended for another patient due to referring general practitioner error.** A patient at a medical imaging practice had a CT pulmonary angiogram intended for another patient. The referring general practitioner contacted the practice when the scan report was received and advised them that the wrong name had been placed on the referral. The effective dose from the CT pulmonary angiogram was about 5.5 mSv. The general practitioner was reminded to be careful when placing patients' names on referrals.
Incident 124	**A patient underwent a CT scan intended for another patient due to hospital orderly and radiographer error.** A patient under COVID precautions in the emergency department of a hospital was brought to the attached medical imaging practice by a hospital orderly for a CT scan of the head. As the practice did not permit COVID patient notes in the scan room, the radiographer needed to identify the patient from memory. After the patient was returned to the emergency department it was found that the wrong patient had been brought for the scan. The intended patient had the same surname as the scanned patient. The effective dose from the CT scan was about 2 mSv. The hospital orderly was reminded to be careful in selecting patients to be taken for imaging. Staff members were reminded to use extra care when dealing with COVID patients.
Incident 125	**A patient underwent a CT scan intended for another patient due to referring physician error.** A hospital patient was referred for a CT scan of the abdomen and pelvis with contrast. The referring physician entered the wrong patient details on the request. The error was identified after the patient returned to the ward. The effective dose due to the scan was about 3 mSv. The referring physician was reminded to be careful when placing patients' names on referrals.

Wrong patient underwent a medical procedure (continued)

Incident no.	Description of incident
Incident 126	**A patient underwent a CT scan intended for another patient due to referring physician error.** A hospital patient was referred for a CT scan of the thoraco lumbar spine. The referring physician entered the wrong patient details on the request. The error was identified after the patient returned to the ward. The effective dose due to the scan was about 18 mSv. The referring physician was reminded to be careful when placing patients' names on referrals.
Incident 127	**A patient underwent a CT scan intended for another patient due to radiographer error.** A hospital patient underwent a CT scan of the brain and circle of Willis intended for another patient. The first patient was not correctly identified by the radiographer. The effective dose due to the scan was about 6.4 mSv. The radiographer was reminded to carry out the hospital's patient and procedure identification process.
Incident 128	**A patient underwent a CT scan intended for another patient due to referring physician error.** The wrong patient was referred for a CT scan of the abdomen and pelvis by an emergency department (ED) physician. After the scan, the ED physician realised that the scan had been ordered for the wrong patient. The effective dose due to the scan was about 6 mSv. The referring physician was reminded to be careful when placing patients' names on referrals.
Incident 129	**A patient underwent a CT scan intended for another patient due to referring physician error.** A hospital patient underwent a non-contrast CT scan of the brain intended for another patient when a referral was sent from the general medicine team to the radiology department with the identification details of the wrong patient. The effective dose due to the scan was about 1.8 mSv. The physicians in the medical and referring teams were reminded to be careful when placing patients' names on referrals.
Incident 130	**A patient underwent a CT scan intended for another patient due to referring physician error.** A hospital patient underwent a CT scan of the brain intended for another patient because the referring physician put the wrong patient label on the referral. The effective dose due to the scan was about 13 mSv. The referring physician was reminded to be careful when placing patients' names on referrals.
Incident 131	**A patient underwent a CT scan intended for another patient due to radiographer error.** A patient presented to a medical imaging practice for a non-contrast CT scan of the brain. The patient also had a post contrast phase CT scan of the brain and CT scan of the cervical spine in error. The radiographer failed to perform the time out procedure correctly and performed the post contrast brain scan and cervical spine requested for a different patient. The effective dose due to the scan was about 5.3 mSv. The radiographer was reminded to carry out patient and procedure identification processes thoroughly.
Incident 132	**A patient underwent a CT scan intended for another patient due to radiographer error.** A patient presented to the radiology department of a hospital for general radiographic imaging of the lumbar spine. The radiographer called for a different patient with the same first name who had presented for a CT scan of the lumbar spine. The radiographer failed to perform the time out procedure correctly and carried out a CT scan of the lumbar spine on the patient, instead of the required plain X-rays of the lumbar spine. The effective dose due to the scan was about 11 mSv. The radiographer was reminded of the importance of carrying out patient and procedure identification processes thoroughly.

Wrong patient underwent a medical procedure (continued)

Incident no.	Description of incident
Incident 133	**A patient underwent X-rays intended for another patient due to radiographer error.** A hospital physician requested that a radiographer perform an AP chest X-ray on a patient. The radiographer registered the request but wrote down the incorrect room number. The radiographer then performed an AP chest X-ray on the wrong patient. The effective dose due to the scan was about 0.03 mSv. The radiographer was reminded to get all required identifiers for patients before imaging.
Incident 134	**A patient underwent a scan intended for another patient due to nuclear medicine technologist error.** A patient attended a medical imaging practice for a whole-body nuclear medicine bone scan. The patient had a localised bone scan and a SPECT/CT scan intended for another patient instead. The nuclear medicine technologist had not reviewed the referral form adequately and had not used the practice's patient identification procedures correctly. The effective dose due to the scan was about 5.9 mSv. Medical imaging staff members at the practice were reminded correctly to use the practice's patient identification procedures.
Incident 135	**A patient underwent a CT scan intended for another patient due to radiographer error.** A radiographer at a medical imaging practice attended the CT scan waiting area to collect a patient for a CT scan of the brain. Three patients were present and the wrong patient responded when the name of the required patient was called. The radiographer did not use the practice's timeout process to identify the patient. After the scan it became apparent that the wrong patient had been scanned. The effective dose due to the scan was about 1.5 mSv. The radiographer was reminded of the importance of carrying out patient and procedure identification processes thoroughly.
Incident 136	**A patient underwent a CT scan intended for another patient due to radiographer error.** A patient at a medical imaging practice attended for a CT scan of the abdomen and pelvis (CTAP). At the same time, another patient was booked in for a CT pulmonary angiogram (CTPA). The patient who required a CTAP had the CTPA instead as the radiographer did not carefully read the referral. The effective dose due to the scan was about 6.1 mSv. The radiographer was reminded of the importance of carrying out patient and procedure identification processes thoroughly.
Incident 137	**A patient underwent a CT scan intended for another patient due to radiographer error.** A radiographer at a medical imaging practice attended the CT waiting area to collect a patient for a CT scan of the brain. Three patients were present and one patient responded when the name was called. The patient who responded to the call had a referral for a CT scan of the elbow. The radiographer did not carry out the required patient and procedure identification processes. The effective dose due to the brain scan was about 1.5 mSv. The radiographer was reminded of the importance of carrying out patient and procedure identification processes thoroughly.
Incident 138	**A patient underwent a CT scan intended for another patient due to radiographer error.** A patient attended a medical imaging practice for a CT scan of the chest, abdomen and pelvis. The radiographer called out the patient name but did not use the practice's patient and procedure identification processes. The wrong patient was scanned. The effective dose due to the scan was about 35 mSv. The radiographer was reminded of the importance of carrying out patient and procedure identification processes thoroughly.

Wrong patient underwent a medical procedure (continued)

Incident no.	Description of incident
Incident 139	**A patient underwent a scan intended for another patient due to nuclear medicine technologist error.** A patient attended a medical imaging practice with a referral for a nuclear medicine scan of the thyroid. The thyroid scan was carried out. The nuclear medicine technologist did not carry out patient and procedure identification processes thoroughly. The hospital physician who wrote the referral subsequently advised the practice that the incorrect patient sticker was placed on the referral. The effective dose due to the scan was about 2.3 mSv. The referring physician was reminded to be careful when placing patients' names on referrals. Nuclear medicine technologists at the practice were reminded of the importance of carrying out patient and procedure identification processes thoroughly.

Patient underwent incorrect medical procedure

Incident no.	Description of incident
Incident 140	**A patient underwent a three-phase CT scan of the of the abdomen and pelvis instead of the intended single-phase scan due to radiographer error.** A hospital patient presented for a CT scan of the abdomen and pelvis querying the source of rectal bleeding. The duty radiologist consulted with the referring physician prior to protocolling the request and it was agreed that only a single-phase CT scan was required. The radiographer incorrectly selected a three-phase CT scan protocol and imaged the patient, resulting in three scans of the abdomen and pelvis instead of one scan. The effective dose due to the two unnecessary phases was about 13 mSv. The Senior CT Radiographer at the hospital counselled the radiographer regarding the importance of reviewing the imaging request and correctly selecting the required scan protocol.
Incident 141	**A patient underwent a full body nuclear medicine bone scan instead of a dual-energy X-ray absorptiometry (DXA) scan due to referring physician error.** A patient at a medical imaging practice underwent a full body nuclear medicine bone scan instead of a DXA scan as the referring physician had requested the wrong scan. The nuclear medicine technologist involved did not check the clinical indications prior to imaging. The effective dose due to the unnecessary nuclear medicine scan was about 3.2 mSv. The referring physician was reminded to be careful when filling out referrals. Medical imaging staff at the practice were reminded to check the clinical indications to justify the requested examination.
Incident 142	**A patient underwent a CT scan of the thoracic spine instead of the lumbar spine due to clerical error.** A patient was referred to a medical imaging practice for a CT scan of the lumbar spine but the patient was incorrectly booked for a CT scan of the thoracic spine by clerical staff. The radiographer performing the scan did not check the referral. The effective dose due to the unnecessary thoracic spine CT scan was about 7 mSv. Clerical staff members were reminded to exercise care when entering patient and procedure details on imaging requests. The radiographer was reminded to check all pertinent patient information before carrying out imaging procedures.
Incident 143	**A patient underwent a CT scan of the of the chest instead of the intended CT scan of the facial bones due to radiographer error.** A hospital patient underwent a CT exam of chest when a CT of the facial bones was requested by the referring practitioner and correctly protocolled by the radiologist. The radiographer did not thoroughly verify the CT examination requested. The effective dose due to the unnecessary chest scan was about 1.3 mSv. The radiographer was reminded of the importance of reviewing the imaging request and selecting the required scan protocol.

Patient underwent incorrect medical procedure (continued)

Incident no.	Description of incident
Incident 144	**A patient underwent a CT scan of the chest, abdomen and pelvis (CAP) instead of the intended CT scan of the brain due to radiographer error.** A patient presented to a medical imaging practice with a referral for a CT scan of the brain. The patient's examination was booked incorrectly by clerical staff as a CAP CT scan instead of CT scan of the brain. The radiographer consulted the electronic records system but did not check the referral and performed the CAP CT scan. The effective dose due to the unnecessary CAP scan was about 11 mSv. The radiographer was reminded of the importance of reviewing the referral.
Incident 145	**A patient underwent a CT scan of the wrong region of the spine due to radiographer error.** A patient attended a medical imaging practice for a CT scan of the thoracic spine but had a CT scan of the lumbar spine in error as the radiographer did not thoroughly review the referral. The effective dose due to the scan was about 8 mSv. The radiographer was reminded of the importance of reviewing the referral carefully.
Incident 146	**A patient underwent a CT scan of a greater anatomic region than required due to radiographer error.** A hospital patient was referred for a CT brain perfusion study requiring a scan acquisition from the cervical spine C2 upwards. The radiographers wrongly selected the scan to be from the aortic arch upwards. The additional effective dose was about 2.9 mSv. The radiographers were reminded of the importance of correctly selecting the required scan range.
Incident 147	**A patient underwent a CT scan of the wrong anatomical region due to clerical and radiographer error.** A patient presented to a medical imaging practice with a referral for a CT scan of the chest but the receptionist consulted an old referral, registered in the electronic ordering system, for a CT scan of the kidneys, ureters and bladder (KUB) for the patient. The patient was unaware of what area was to be scanned. A CT scan of the KUB was completed. The CT scan of the chest was not carried out. The effective dose due to the CT scan of the KUB was about 4.4 mSv. Receptionists at the practice were reminded of the importance of looking carefully at referrals and ensuring that the patient and procedure details were the same as those scanned into the electronic ordering system. Radiographers were reminded to check referral dates and speak to the radiologist or referring physician if ever in doubt about a scan.
Incident 148	**A patient underwent a CT scan of the wrong anatomical region due to radiographer error.** A hospital patient was referred for a CT scan of the chest but had a CT scan of the abdomen and pelvis in error. The radiographer did not thoroughly verify the CT examination requested by the referring physician and correctly protocolled by the radiology registrar. The effective dose due to the scan was about 3.5 mSv. The radiographer was counselled regarding the importance of selecting the correct region for a scan.
Incident 149	**A patient underwent a wrong CT scan due to radiographer error.** A patient at a medical imaging practice was booked in for a CT thoracic angiogram. The radiographer did not take the time to read the referral properly and assumed the scan was a CT aortic bifemoral angiogram and scanned the patient accordingly. The mistake was noticed once the patient had left the department. The effective dose due to the scan was about 4.4 mSv. The radiographer was reminded of the importance of taking the time to read through the details of referrals thoroughly prior to scanning.

Patient underwent incorrect medical procedure (continued)

Incident no.	Description of incident
Incident 150	**A patient underwent a wrong CT scan due to radiographer error.** A patient attended a medical imaging practice with a referral for a CT arterial portography (CTAP). The scan was incorrectly entered into the electronic ordering system as a CT pulmonary angiogram (CTPA). The radiographer only used the electronic ordering system to determine what scan was required and carried out a CTPA. The radiographer did not read the referral. The effective dose due to the CTPA was about 6.6 mSv. The radiographer was reminded of the importance of reading referrals thoroughly prior to scanning.
Incident 151	**A patient underwent a wrong CT scan due to radiographer error.** A patient attended a medical imaging practice for a CT scan. The emergency department of the hospital to which the practice was attached had sent a referral for a CTAP (CT arterial portography). The radiographer misread it as a CTPA (CT pulmonary angiogram). A CTPA was performed. The effective dose due to the CTPA was about 6.6 mSv. The radiographer was reminded of the importance of reviewing the referral and correctly identifying the patient and procedure.

Patient underwent a medical procedure on the wrong anatomical region

Incident no.	Description of incident
Incident 152	**A patient underwent a CT scan of the wrong anatomical region due to radiographer error.** A hospital patient underwent a CT scan of the chest when a CT scan of the abdomen had been requested. The radiographer did not thoroughly carry out patient identification and procedure matching processes. The effective dose due to the CT scan of the chest was about 2.5 mSv. The radiographer was reminded to carry out patient and procedure identification processes thoroughly.
Incident 153	**A paediatric patient underwent an X-ray of the wrong anatomical region due to supervising radiographer error.** A paediatric hospital patient was referred for an X-ray of the elbow. This examination was being conducted by an intern radiographer and a supervising radiographer. The supervising radiographer erroneously entered an abdomen protocol instead of the elbow protocol as required. The patient was correctly positioned for the elbow scan but the patient's elbow was scanned using the abdominal exposure factors. The examination had to be repeated with the correct elbow exposure factors. The effective dose due to the first X-ray was about 0.01 mSv. The supervising radiographer was reminded to concentrate on the scan being carried out.
Incident 154	**A patient underwent a CT scan of the wrong anatomical region due to referring physician error.** A patient presented to a hospital with a referral for a CT scan of the right humerus for the further characterisation of right humeral bony metastases. After the scan, the patient told the radiographers that they did not understand why the right arm was being imaged when it was the left arm that was sore. The referring physician was contacted and advised the radiographers that the scan had been requested for the wrong side. The effective dose due to the CT scan was about 7.1 mSv. The referring physician was reminded to be diligent when completing referrals.
Incident 155	**A patient underwent a CT scan of the wrong anatomical region due to radiographer error.** A patient had a CT scan of the shoulder when a CT scan of the cervical spine had been requested. The patient said they were there to have the shoulder scanned because of pain in the scapula. The radiographer did not consult the referral prior to carrying out the scan. The effective dose due to the CT scan of the shoulder was about 5.4 mSv. The radiographer was reminded thoroughly to carry out patient and procedure identification processes.

Patient underwent a medical procedure on the wrong anatomical region (continued)

Incident no.	Description of incident
Incident 156	**A paediatric patient underwent an X-ray of the wrong anatomical region due to radiographer error.** A paediatric hospital patient was referred from the emergency department for an X-ray of the hand and wrist to query a fracture of the second right metatarsal bone ("MT" on the referral). The MT is a bone in the foot. The radiographer assumed that "MT" was in error and should have been "MC" for metacarpal – a bone in the hand. The radiographer could not identify a healing second MC fracture and contacted the referring practitioner who confirmed that the X-ray should have been of the foot. The effective dose due to the X-ray of the hand was about 0.00002 mSv. The referring physician was reminded to be careful when completing referrals. The radiographer was reminded to seek advice in cases of uncertainty.
Incident 157	**A paediatric patient underwent an X-ray of the wrong anatomical region due to radiographer error.** A paediatric hospital patient presented for plain X-rays of the left tibia and fibula. The patient had a back slab and bandage on the right leg (the incorrect leg). The back slab and bandage were placed on the patient's leg by the patient's father and the father placed the right leg to be imaged. The radiographer did not consult the referral. The effective dose due to the X-ray was about 0.0001 mSv. The radiographer was reminded to consult the referral before carrying out an imaging procedure.
Incident 158	**A paediatric patient underwent an X-ray of the wrong anatomical region due to referring physician error.** A paediatric patient presented to a hospital for a plain X-ray of the right tibia and fibula but the fracture to be examined was on the left side. The referring physician had requested an X-ray of the wrong side. The effective dose due to the X-ray was about 0.0003 mSv. The referring physician was reminded to be careful when completing referrals.
Incident 159	**A paediatric patient underwent an X-ray of the wrong anatomical region due to radiographer error.** A paediatric hospital patient had a plain X-ray of the left tibia and fibula when the right tibia and fibula required imaging. The patient's mother indicated to the radiographer that the left side had to be imaged. The radiographer did not consult the referral. The effective dose due to the X-ray was about 0.01 mSv. The radiographer was reminded to consult the referral before carrying out an imaging procedure.
Incident 160	**A patient underwent a CT scan of the wrong anatomical region due to radiographer error.** A patient at a medical imaging practice had a CT scan of the chest instead of a CT scan of the abdomen as requested because the radiographer failed correctly to perform the steps of the time out procedure. The effective dose due to the scan was about 4.5 mSv. The radiographer was reminded thoroughly to carry out patient and procedure identification processes.
Incident 161	**A patient underwent a CT scan of the wrong anatomical region due to radiographer error.** A patient attended a medical radiation practice for a CT scan of the left shoulder. The radiographer did not carefully read the referral and carried out a CT scan of the right shoulder in error. The effective dose due to the scan was about 3.1 mSv. The radiographer was reminded to carry out patient and procedure identification processes thoroughly before scanning a patient.

Patient underwent a medical procedure using the wrong modality

Incident no.	Description of incident
Incident 162	**A patient underwent a CT scan of the chest, abdomen and pelvis instead of a plain X-ray of the chest, abdomen and pelvis due to radiologist and radiographer error.** A patient attended a medical imaging practice with a referral for a plain X-ray of the chest, abdomen and pelvis. The referral was reviewed by the radiologist and approved as a CT scan of the chest, abdomen and pelvis. The referral was unclear as to the modality requested. Neither the radiologist nor the radiographer checked the procedure requested with the referring physician. The effective dose due to the CT scan was about 23 mSv. The radiologist and the radiographer were reminded to check with the referring physician when there is uncertainty about a referral.
Incident 163	**A patient underwent a CT scan of the lumbar spine instead of an ultrasound scan of the lumbar spine due to radiographer error.** A patient attended a medical imaging practice with a referral for an ultrasound scan of the lumbar spine but was booked in for a CT scan of the lumbar spine. The radiographer had not sighted the request prior to proceeding with the scan. The effective dose due to the CT scan was about 8 mSv. The radiographer was reminded to use correct patient and procedure identification processes at all times. Clerical staff members were reminded to exercise care when entering patient and procedure details on imaging requests.
Incident 164	**A patient underwent a plain radiograph of the lumbar spine instead of the intended CT scan of the lumbar spine due to radiographer error.** A patient presented to a medical imaging practice for a CT scan of the lumbar spine and had a lumbar spine two view radiograph in error. The radiographer misread the referral as a lumbar spine X-ray not a lumbar spine CT scan. The effective dose due to the X-ray was about 1.8 mSv. The radiographer was reminded to perform the steps of the time out process of the practice thoroughly.

High patient dose during an interventional or fluoroscopic procedure

Incident no.	Description of incident
Incident 165	**A patient underwent a cardiac angioplasty procedure that resulted in a high radiation dose to the skin.** A hospital patient underwent a cardiac angioplasty procedure under fluoroscopic guidance. Throughout the procedure, steps were taken to keep the dose as low as possible. The skin entrance dose for the procedure was about 6.2 Gy. The patient did not develop any erythema. No further action was necessary.
Incident 166	**A patient underwent a cerebral coiling procedure that resulted in a high radiation dose to the skin.** A hospital patient underwent a cerebral coiling procedure under fluoroscopic guidance. Throughout the procedure, steps were taken to keep the dose as low as possible. The skin entrance dose for the procedure was about 6.4 Gy. The patient did not develop any erythema. No further action was necessary.
Incident 167	**A patient underwent a portal vein embolisation procedure that resulted in a high radiation dose to the skin.** A hospital patient underwent a portal vein embolisation procedure under fluoroscopic guidance. Throughout the procedure, steps were taken to keep the dose as low as possible. The skin entrance dose for the procedure was about 6.5 Gy. The patient did not develop any erythema. No further action was necessary.

High patient dose during an interventional or fluoroscopic procedure (continued)

Incident no.	Description of incident
Incident 168	**A patient underwent a superior vena cava stenting procedure that resulted in a high radiation dose to the skin.** A hospital patient underwent a complex superior vena cava stenting procedure under fluoroscopic guidance. Throughout the procedure, steps were taken to keep the dose as low as possible. The skin entrance dose for the procedure was about 10 Gy. The patient did not develop any erythema. No further action was necessary.
Incident 169	**A patient underwent a repair of an arterial aneurysm and femoral artery that resulted in a high radiation dose to the skin.** A hospital patient underwent a repair of a left common iliac artery aneurysm and left common femoral artery under fluoroscopic guidance. Throughout the procedure, steps were taken to keep the dose as low as possible. The skin entrance dose for the procedure was about 14 Gy. The patient developed mild erythema. No further action was necessary.
Incident 170	**A patient underwent an endovascular repair procedure that resulted in a high radiation dose to the skin.** A hospital patient underwent an endovascular repair procedure under fluoroscopic guidance. Throughout the procedure, steps were taken to keep the dose as low as possible. The skin entrance dose for the procedure was about 6.7 Gy. The patient did not develop any erythema. No further action was necessary.
Incident 171	**A patient underwent a cerebral aneurysm embolisation that resulted in a high radiation dose to the skin.** A hospital patient underwent a cerebral aneurysm embolisation under fluoroscopic guidance. Throughout the procedure, steps were taken to keep the dose as low as possible. The skin entrance dose for the procedure was about 7.6 Gy. The patient did not develop any erythema. No further action was necessary.
Incident 172	**A patient underwent an abdominal angiography procedure that resulted in a high radiation dose to the skin.** A hospital patient underwent an abdominal angiography procedure under fluoroscopic guidance. Throughout the procedure, steps were taken to keep the dose as low as possible. The skin entrance dose for the procedure was about 5.8 Gy to 8.3 Gy. The patient did not develop any erythema. No further action was necessary.
Incident 173	**A patient underwent a trans-arterial chemoembolisation procedure that resulted in a high radiation dose to the skin.** A hospital patient underwent a trans arterial chemoembolisation procedure under fluoroscopic guidance. Throughout the procedure, steps were taken to keep the dose as low as possible. The skin entrance dose for the procedure was about 6.4 Gy. The patient did not develop any erythema. No further action was necessary.
Incident 174	**A patient underwent an abdominal branch embolisation procedure that resulted in a high radiation dose to the skin.** A hospital patient underwent an abdominal branch embolisation procedure under fluoroscopic guidance. Throughout the procedure, steps were taken to keep the dose as low as possible. The skin entrance dose for the procedure was about 6.4 Gy. The patient did not develop any erythema. No further action was necessary.

Unnecessary radiation exposure due to equipment failure

Incident no.	Description of incident
Incident 175	**A patient had part of a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient underwent a CT scan of the abdomen and pelvis. When the images were reviewed, there was an artefact through a section of the pelvis making the image undiagnostic. A section of the scan through the pelvis was repeated. The effective dose from the repeated segment of the scan was about 7 mSv. A service engineer from the supplier came and rectified the problem.
Incident 176	**A patient had a CT scan unnecessarily repeated due to a contrast injector malfunction.** A hospital patient underwent a repeated carotid angiogram CT scan due to contrast injector malfunction. During contrast injection, an error was noted on the contrast injector. However, contrast monitoring scans showed contrast opacification and the decision to go ahead with the scan was made. Upon review of the images, it was apparent that the volume of contrast delivered was insufficient and the scan had to be repeated. The effective dose from the scan was about 4 mSv. The contrast injector manufacturer was contacted and rectified the problem.
Incident 177	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient was undergoing a CT perfusion scan of the brain when the CT scanner malfunctioned part way through the scan. The scan needed to be repeated. The effective dose from the initial scan was about 3.1 mSv. The equipment supplier rectified the problem.
Incident 178	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient was referred for a CT scan of the chest with contrast. The patient underwent scout view imaging without error. During main scan acquisition, however, a fault with the X-ray tube electrical current occurred, terminating the scan prematurely. The scan had to be repeated. The effective dose from the initial (terminated) scan was about 5.1 mSv. The equipment supplier rectified the problem.
Incident 179	**A patient had a PET scan unnecessarily repeated due to equipment malfunction.** A patient attended a medical imaging centre for a PET scan. During the scan, the CT slip ring tripped the circuit breakers causing the PET machine to malfunction. As a result, the scan had to be aborted. The effective dose from the initial (terminated) scan was about 3.8 mSv. Engineers from the supply company diagnosed the issue and replaced a faulty part.
Incident 180	**A patient had a radiopharmaceutical injection unnecessarily repeated due to equipment malfunction.** A patient attended a medical radiation clinic for a PET/CT scan. The patient was injected with 170 MBq of ^{18}F-FDG. During the patient's uptake phase, the PET/CT scanner stopped working due to a fault with the CT chiller cooling unit. The scanner was over-heated and could not be used. The scan was rebooked for another day. The effective dose from the radiopharmaceutical injection was about 3.1 mSv. The CT chiller unit was repaired by service technicians overnight.
Incident 181	**A patient had a radiopharmaceutical injection unnecessarily repeated due to equipment malfunction.** A patient attended a medical radiation clinic for a PET/CT scan. The patient was injected with 192 MBq of ^{68}Ga-dotatate. During the patient's uptake phase, the PET/CT broke down and was no longer functional. The scan was rebooked for another day. The effective dose from the radiopharmaceutical injection was about 4.4 mSv. Service technicians attended and rectified the issue.

Unnecessary radiation exposure due to equipment failure (continued)

Incident no.	Description of incident
Incident 182	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A patient attended a medical imaging practice for a PET/CT scan. The patient was injected with 324 MBq of ^{18}F-FDG. Image reconstruction showed an artefact and, as a result, the PET data were not diagnostic. The scanner was shut down and restarted and the patient was re scanned. No further injection of FDG was required, but an additional CT scan was required for attenuation correction purposes. The effective dose from the extra CT scan was about 7.9 mSv. The supply company investigated the malfunction and rectified the problem.
Incident 183	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient underwent a CT scan of the abdomen and pelvis. A review of the images showed that a portion of the images was non diagnostic due to an X-ray tube arc error. The anatomical area not imaged properly was rescanned. The effective dose from the repeated portion of the scan was about 5 mSv. The supply company advised that a low mA tube warm up and seasoning would prevent this problem recurring. Seasoning involves raising the tube current and voltage gradually to reduce any residual gas in the X-ray tube before the tube is operated at full output.
Incident 184	**A patient had a radiopharmaceutical injection unnecessarily repeated due to equipment malfunction.** A patient at a medical imaging practice was injected with 193 MBq of ^{18}F-FDG for a PET scan. Before the patient could be scanned, the scanner gantry reported an error. The patient's scan had to be rescheduled for a later date. The effective dose from the radiopharmaceutical injection was about 3.3 mSv. Service technicians attended and rectified the issue.
Incident 185	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient had a CT scan of the abdomen as part of a PET/CT study. The reconstruction of the images was corrupted and the problem could not be resolved so the abdomen had to be re scanned. The effective dose from the scan was about 1.9 mSv. A service technician attended but could not identify the cause of the problem. The problem has not recurred.
Incident 186	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient had a whole-body CT scan as part of a PET/CT study. The reconstruction of the images failed and the problem could not be resolved. The CT scan was repeated. The effective dose from the scan was about 4.7 mSv. A service engineer attended. The event logs indicated that the reconstruction failed to complete due to the inability to read data from the hard disks. The service engineer identified the faulty hardware and replaced the faulty parts.
Incident 187	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient had to have a CT scan of the brain repeated due to an equipment malfunction. The images obtained from the first scan contained artefacts and were non-diagnostic. The effective dose from the scan was about 1.4 mSv. A service technician from the supplier was contacted and investigated the error. A faulty control board was replaced.
Incident 188	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A patient at a medical imaging practice had a CT scan of the brain. After the patient had left, the radiographer noticed that there was a significant artefact in all the images, both in the raw data and the reformats. The patient had to be recalled and have the scan again. The effective dose from the scan was about 3.2 mSv. The CT scanner was switched off and on again and re-calibrated.

Unnecessary radiation exposure due to equipment failure (continued)

Incident no.	Description of incident
Incident 189	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient was undergoing a CT scan of the brain. There was arcing in the CT scanner tube part way through the scan. The scan needed to be repeated. The effective dose from the initial scan was about 2.5 mSv. A tube scan check was performed prior to returning the equipment to clinical use.
Incident 190	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient was undergoing a CT scan of the brain. There was arcing in the CT scanner tube part way through the scan. The scan needed to be repeated. The effective dose from the initial scan was about 3 mSv. Supply company engineers attended the site and performed an X-ray tube seasoning. A further tube arc occurred, and the engineers changed the X-ray tube.
Incident 191	**A patient had a radiopharmaceutical injection unnecessarily repeated due to equipment malfunction.** A patient at a medical imaging practice was injected with 157 MBq of ^{18}F-FDG for a PET scan. Before the patient could be scanned, multiple error messages appeared on the scanning computer. The PET gantry had become un-operational due to over-heating. The patient's scan had to be rescheduled. The effective dose from the radiopharmaceutical injection was about 2.9 mSv. Service technicians attended and rectified the issue.
Incident 192	**A patient had a radiopharmaceutical injection unnecessarily repeated due to equipment malfunction.** A patient at a medical imaging practice was injected with 311 MBq of ^{18}F-FDG for a PET scan. Before the patient could be scanned, multiple error messages appeared on the scanning computer. The PET gantry had become un-operational due to over-heating. This problem was the same equipment failure as had occurred in the previous incident. Both patients were injected with the ^{18}F-FDG before the failure occurred. The patient's scan had to be rescheduled. The effective dose from the radiopharmaceutical injection was about 5.3 mSv. Service technicians attended and rectified the issue.
Incident 193	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient had a low-dose whole body CT scan as part of a PET/CT study. The scan completed but the reconstruction failed. The problem could not be resolved and the scan had to be repeated. The effective dose from the scan was about 3.3 mSv. Service technicians attended and rectified the issue.
Incident 194	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A low dose CT scan being carried out on a hospital patient had to be repeated due to the malfunction of the PET/CT hybrid imaging system. The effective dose from the scan was about 5.9 mSv. Service technicians attended and replaced a component identified as being faulty.
Incident 195	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient had a whole-body multi slice CT scan (pan scan). The reconstruction server of the CT failed part way through reconstruction. An engineer from the supplier was contacted and only the cervical spine portion of the scan was able to be recovered. Following clinical review by the emergency physician and radiologist, a CT scan of the chest, abdomen and pelvis and CT scan of the brain were carried out. The effective dose from the repeated parts of the scan was about 9 mSv. Service technicians attended and replaced a server part identified as being faulty.

Unnecessary radiation exposure due to equipment failure (continued)

Incident no.	Description of incident
Incident 196	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A patient attended a medical imaging practice for a CT coronary angiogram. Contrast was injected and the scan stopped after a few slices. The scan was attempted a second time with a second bolus of contrast and the scan aborted again. A service technician from the supplier determined that the malfunction was due to the tube arcing and said that the tube needed to be replaced. The effective dose from the scans was about 4.6 mSv. A service technician replaced the X-ray tube.
Incident 197	**A paediatric patient had a CT scan unnecessarily repeated due to equipment malfunction.** A paediatric hospital patient presented for a CT scan of the chest with contrast. During the final part of the scan, the system unexpectedly produced an error message on commencement of the helical acquisition and therefore the required imaging was not completed. The effective dose from the scan was about 0.12 mSv. A service technician found that the sensor that monitors the angular rotation was faulty. The sensor was replaced.
Incident 198	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient was referred for a PET/CT scan. The low dose CT and scout scans were completed without error. A few minutes into the PET scan an error message came up on the computer. The patient was moved to another scanner to have the scan. The low dose CT and scout scans had to be repeated. The effective dose from the scans was about 4.3 mSv. A service technician was called. Faulty parts were replaced.
Incident 199	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** The low-dose CT scan of a PET/CT study of a hospital patient was performed but the PET acquisition and reconstruction failed to complete due to an unknown imaging system freeze. A full power cycle rectified the imaging system but the acquired data could not be retrieved. The PET/CT whole-body scan of the patient was repeated on another PET/CT imaging system. The effective dose from the repeated low dose CT scan was about 4.5 mSv. Service technicians attended and rectified the issue.
Incident 200	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A patient attended a medical imaging practice for a PET scan for lung cancer staging. The patient was injected for the scan but at the time the scan was to be carried out the scanner experienced gantry failure and was not available for scanning. The patient was reinjected and scanned once the PET scanner was repaired. The effective dose from the scan was about 13 mSv. Service technicians attended and replaced the component moderating the voltage on the machine.
Incident 201	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient underwent a partially repeated contrast-enhanced CT scan of the abdomen and pelvis. A scanner fault occurred part way through the examination. The patient was moved to another scanner and the scan was completed successfully. The effective dose from the repeated part of the scan was about 3 mSv. Service technicians attended and investigated the error. The service technicians replaced a faulty component.
Incident 202	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A patient attended a medical imaging practice for a CT pulmonary angiogram (CTPA). The radiographer had to repeat the scan due to insufficient contrast uptake in the pulmonary trunk. A software error caused the limited contrast, resulting in an undiagnostic image. This was a one-off error. The effective dose from the scan was about 6.1 mSv. No further action was necessary and this error did not happen again.

Unnecessary radiation exposure due to equipment failure (continued)

Incident no.	Description of incident
Incident 203	**A patient had a radiopharmaceutical injection unnecessarily repeated due to equipment malfunction.** A patient attended a medical imaging practice for a PET/CT scan. The patient was injected with 199 MBq of ^{18}F. The CT component of the unit failed and was unable to be fixed in time for the CT scan. The patient had to be rebooked for the procedure. The effective dose from the radiopharmaceutical injection was about 3.7 mSv. The machine was repaired by a service technician and returned to service.
Incident 204	**A paediatric patient had a panoramic dental radiograph unnecessarily repeated due to equipment malfunction.** A paediatric patient attended a medical imaging practice for a panoramic dental radiograph. About five seconds into the scan the whole machine turned off. The effective dose from the scan was about 0.02 mSv. The fault was investigated by a service technician from the supplier who deemed it not repairable. The machine was replaced with a new one.
Incident 205	**A paediatric patient had a plain X-ray unnecessarily repeated due to equipment malfunction.** A paediatric hospital patient presented for an antero-posterior X-ray of the pelvis. The radiographer used a nonroutine automatic exposure control (AEC) pelvis protocol. For the first exposure, the AEC system did not terminate the exposure until the backup timer cut off the exposure. This resulted in an overexposed image. The vertical bucky ion chambers, which control the amount of radiation used, were subsequently found to be malfunctioning. The radiographer took a second exposure, with the intention of using manual control, but inadvertently used AEC and this again resulted in an over-exposed image. The radiographer called a senior radiographer for assistance and a third diagnostic image was taken successfully with manual exposure. The effective dose from the two additional exposures was about 8 mSv. The radiographer received education and training in the use of AEC. The vertical bucky AEC chambers were repaired and tested for performance.
Incident 206	**A paediatric patient had a dental X-ray unnecessarily repeated due to equipment malfunction.** A paediatric patient presented to a medical imaging centre for a panoramic radiograph and lateral cephalogram. An equipment failure occurred during the lateral cephalogram and the scan had to be repeated. The effective dose from the scan was about 0.01 mSv. The supplier advised that no corrective action was required.
Incident 207	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A patient presented to a medical imaging centre for a full spiral coronary CT. The gantry of the CT scanner powered off mid-scan. A service technician from the supplier attended and advised to do a full restart of the machine. This was done and a diagnostic was completed successfully. The technician could not see any faults after the restart and advised it was safe to continue scanning. The scan was repeated. The effective dose from the first scan was about 37 mSv. No further action was necessary.
Incident 208	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient had a CT scan of the chest. An equipment fault caused a system failure and the patient images were lost. The effective dose from the scan was about 2 mSv. The supplier advised that the scanner could still be used clinically and that they would continue to monitor the scanner. The system fault did not recur.

Unnecessary radiation exposure due to equipment failure (continued)

Incident no.	Description of incident
Incident 209	**A patient had a PET scan unnecessarily repeated due to equipment malfunction.** A hospital patient presented to the nuclear medicine department for a whole-body PET/CT scan plus cardiac-gated PET imaging. The wholebody PET/CT scan occurred without incident. Upon starting the cardiac gated PET acquisition, the PET system lost communication with the operating system and the imaging failed. The effective dose from the scan was about 1.6 mSv. The supplier diagnosed the problem and provided instructions on how to deal with the error should it reoccur.
Incident 210	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient underwent a repeated CT scan of the thoracic aorta after an artefact was observed in the first scan. The artefact was due to a scanner malfunction. The effective dose from the scan was about 7 mSv. Service technicians from the supplier attended the site and seasoned the X-ray tube.
Incident 211	**A patient had a CT scan unnecessarily repeated due to equipment malfunction.** A hospital patient was having a PET/CT scan. The scanner failed to respond in the middle of the PET scan after having completed the low dose CT scan and four out of nine frames of PET acquisition. The study was repeated on a different PET/CT scanner. The administration of additional radiopharmaceutical was not required for the repeated PET scan. The effective dose from the repeated low-dose whole-body CT scan was about 5.2 mSv. A full power cycle and reboot fixed the problem with the imaging system.

Maladministration of radiopharmaceutical

Incident no.	Description of incident
Incident 212	**A patient was administered with the wrong radiopharmaceutical due to supplier error.** A hospital patient undergoing a nuclear medicine renal scan was injected with 212 MBq ^{99}mTc-MAG3. Radiopharmaceutical uptake was seen in the liver, gallbladder, gastrointestinal system and myocardium, with minimal visualisation of the expected renal system. The biodistribution pattern of the injected radiopharmaceutical was consistent with ^{99m}Tc-MIBI, a cardiac imaging agent. The effective dose as a result of the maladministration, including the dose from the CT scan required as part of the procedure, was about 3.5 mSv. The hospital contacted a supplier representative who advised that the whole batch of that radiopharmaceutical would be isolated pending an investigation.
Incident 213	**A patient was administered with the wrong radiopharmaceutical due to nuclear medicine technologist error.** A hospital patient required a nuclear medicine renal scan. The nuclear medicine technologist drew the radiopharmaceutical from the vial labelled DISIDA instead of DMSA. The patient was rescheduled for a later date to have the correct radiopharmaceutical and correct scan. The effective dose as a result of the maladministration was about 3.1 mSv. The nuclear medicine technologist was reminded of the importance of thoroughly checking vials before drawing up radiopharmaceuticals. The DISIDA vials at the hospital were relabelled with the generic name (HIDA) to avoid confusion with DMSA vials.
Incident 214	**A patient was administered with the wrong radiopharmaceutical due to supplier error.** A hospital patient was administered with 151 MBq of a radioactive tracer that was believed to have been reconstituted ^{99m}Tc-MAA. Upon imaging, it was found that the injected substance was not ^{99m}Tc-MAA. The reconstitution process failed due to a faulty MAA cold kit provided by the supplier. The patient had to be administered with the correct radiopharmaceutical. The effective dose from the first administration was about 2.4 mSv. The hospital instituted routine quality control tests for reconstituted ^{99m}T-MAA.

Maladministration of radiopharmaceutical (continued)

Incident no.	Description of incident
Incident 215	**A patient was administered with an excess amount of a radiopharmaceutical due to nuclear medicine technologist error.** A patient at a medical imaging practice was administered with 559 MBq of ^{18}F–FDG when 180 MBq should have been administered. The error was made by the nuclear medicine technologist, who entered the wrong patient weight as part of the dispensing process. The excess effective dose was about 10.5 mSv. The nuclear medicine technologist was reminded to use care when drawing up radiopharmaceuticals.
Incident 216	**A patient was administered with an excess amount of a radiopharmaceutical due to nuclear medicine technologist error.** A hospital patient was administered with 260 MBq of ^{18}F-FDG for a nuclear medicine PET scan of the brain when 184 MBq was required. The nuclear medicine technologist did not change the computer program sheet from a whole-body scan, which it had been set to for the last procedure, to a brain scan. The computer, therefore, calculated the higher activity. The excess effective dose was about 1.4 mSv. The nuclear medicine technologist was reminded to use care when entering data into computers used to calculate activities to be administered.
Incident 217	**A patient was administered with an excess amount of a radiopharmaceutical due to nuclear medicine technologist error.** A hospital patient presented for a PET brain study and was administered with 348 MBq ^{18}F-FDG when they were supposed to be administered with 200 MBq. The scan was successfully completed despite the incorrect administered activity. The excess effective dose was about 2.7 mSv. The nuclear medicine technologist was reminded to use care when drawing up radiopharmaceuticals.
Incident 218	**A patient was administered with an excess amount of a radiopharmaceutical due to nuclear medicine technologist error.** A hospital patient presented for a PET brain study with 200 MBq of ^{18}F-FDG. The patient was administered with an activity appropriate for a different type of scan (264 MBq ^{18}F-FDG). The scan was successfully completed despite the incorrect administered activity. The excess effective dose was about 1.1 mSv. The nuclear medicine technologist was reminded to use care when drawing up radiopharmaceuticals.
Incident 219	**A patient was administered with the wrong radiopharmaceutical due to nuclear medicine technologist error.** A patient attended a medical imaging practice for a nuclear medicine renal scan. The nuclear medicine technologist did not check the radiopharmaceutical vial prior to drawing up an injection for the patient. As a result, the incorrect radiopharmaceutical was injected into the patient (^{99m}Tc-nanoscan instead of ^{99m}Tc-MAG3). The patient was rebooked and the correct scan was subsequently performed. The effective dose from the administration of the wrong radiopharmaceutical was about 1 mSv. The nuclear medicine technologist was reminded to use care when drawing up radiopharmaceuticals.

Maladministration of radiopharmaceutical (continued)

Incident no.	Description of incident
Incident 220	**A patient was administered with an excess amount of radiopharmaceutical due to nuclear medicine technologist error.** A patient at a medical imaging practice had a parathyroid scan with 780 MBq ^{99m}Tc-MIBI with a thyroid subtraction scan with 190 MBq ^{99m}Tc-pertechnetate beforehand, when 40 MBq ^{99m}Tc-pertechnetate was required. The nuclear medicine technologist mistakenly prepared a 190 MBq ^{99m}Tc-pertechnetate dose, which is the standard dose for a diagnostic thyroid uptake scan. The error was picked up after seeing higher than usual salivary uptake on imaging. The nuclear medicine physician was informed and determined that a slightly higher dose of ^{99m}Tc-MIBI (780 MBq instead of 700 MBq) should be used for the parathyroid scan to ensure the scan would still be diagnostic. The excess effective dose was about 2.7 mSv. The nuclear medicine technologist was reminded always to check that doses drawn up are correct for the procedure prior to injection.
Incident 221	**A patient was administered with the wrong radiopharmaceutical due to nuclear medicine technologist error.** A hospital patient presented for a bone scan and was to be administered with 744 MBq ^{99m}Tc-MDP. A nuclear medicine technologist had mislabelled a vial of ^{99m}Tc-ECD as ^{99m}Tc-MDP and ^{99m}Tc-ECD was unintentionally administered to the patient. The effective dose from the administration of the wrong radiopharmaceutical was about 5.7 mSv. The nuclear medicine technologist was reminded to use care when dispensing and labelling radiopharmaceuticals.

Radiotherapy – unintended irradiation of healthy tissue or over/underdose to target tissue

Incident no.	Description of incident
Incident 222	**A patient had healthy tissue irradiated and lymph nodes under-irradiated due to positioning error.** A patient at a medical oncology practice had healthy tissue irradiated and lymph nodes under-irradiated for one fraction of 5 Gy. The prescription to the lymph node targets was 50 Gy in 10 fractions. There had been a shift of about 1 cm in vertical position of the patient resulting in a geographical miss of the target. For this fraction, the targets received less than 3.5 Gy. Healthy tissue received a dose of about 1.5 Gy. Radiation therapists were reminded to ensure that the patient does not move between planning images and irradiation.
Incident 223	**A patient had healthy tissue irradiated due radiation therapist error.** A patient at a radiation oncology practice was to have radiation delivered to the lumbar spine with arms raised. The radiation therapists, however, treated the patient with the arms by the side for the first fraction (a total of five fractions were prescribed). All other fractions were delivered correctly. The maximum dose to the arms was about 1.5 Gy. The radiation therapists were reminded to take care in correctly setting up patients for treatment.

Medical procedure failed due to patient non-cooperation or other patient problem

Incident no.	Description of incident
Incident 224	**A patient had an unnecessarily repeated administration of a radiopharmaceutical.** A patient at a medical imaging practice was injected with 322MBq of ^{99m}Tc-DTPA for a nuclear medicine renal scan. After the static images were taken, the patient developed an urgency to void and the dynamic image sequence had to be abandoned. The patient had to return for the dynamic images and was administered an extra 322MBq of ^{99m}Tc-DTPA. The effective dose due to the administration of the ^{99m}Tc-DTPA was about 1.4 mSv. No further action was necessary.
Incident 225	**A patient had an unnecessarily repeated CT scan.** A hospital patient had a CT scan of an unintended region of the torso. The patient moved when the protocol was adjusted for manual timing because the patient was claustrophobic. The scan had to be repeated with the patient sedated. The effective dose due to the CT scan was about 1.5 mSv. No further action was necessary.
Incident 226	**A patient had an unnecessary administration of a radiopharmaceutical.** A patient attended a medical imaging practice for a nuclear medicine myocardial perfusion scan. After being injected with 339 MBq of ^{99m}Tc-MIBI, the patient experienced chest pain due to an inferior wall myocardial infarction. Images could not be acquired as the patient had to be taken to hospital by ambulance. The effective dose due to the administration of the radiopharmaceutical was about 2.3 mSv. No further action was necessary.
Incident 227	**A patient had an unnecessary administration of a radiopharmaceutical.** A patient at a medical imaging practice was injected with ^{99m}Tc-MIBI for a parathyroid scan. At the time of the scan, the patient panicked due to the narrowness of the scanner bed and refused to be scanned. The effective dose due to the administration of the radiopharmaceutical was about 6.5 mSv. No further action was necessary.
Incident 228	**A patient had an unnecessary administration of a radiopharmaceutical.** A hospital patient was injected with 830 MBq of ^{99m}Tc-HDP for a bone scan. The patient was asked to return later for the scan but did not show up. After calling the patient, the patient said that they could not attend the appointment as their mother had a medical emergency and needed to go to hospital. The effective dose due to the administration of the radiopharmaceutical was about 4.2 mSv. No further action was necessary.
Incident 229	**A patient had an unnecessary administration of a radiopharmaceutical.** A patient attended a medical imaging practice for a nuclear medicine bone scan of the foot using ^{99m}Tc-HDP. The initial blood flow and blood pool images were acquired and the patient was asked to return for the delayed scan in three hours' time. The patient did not return at the required time due to difficulty in walking. The effective dose due to the administration of the radiopharmaceutical was about 3.5 mSv. No further action was necessary.
Incident 230	**A patient had an unnecessary administration of a radiopharmaceutical.** A patient attended a medical imaging practice for a nuclear medicine scan. The referring physician cancelled the imaging following the injection of the ^{67}Ga-citrate as the patient was too unwell to proceed with imaging and had emergency surgery scheduled for the following day. In the end, the scan was no longer required. The effective dose due to the administration of the radiopharmaceutical was about 40 mSv. No further action was necessary.

Medical procedure failed due to patient non-cooperation or other patient problem (continued)

Incident no.	Description of incident
Incident 231	**A patient had an unnecessary administration of a radiopharmaceutical.** A patient attended a medical imaging practice for a nuclear medicine bone scan. The patient consented to the injection of the ^{99m}Tc and agreed to come back for the scan. The patient subsequently refused to have the scan despite staff members trying to convince the patient to have the scan. The effective dose due to the administration of the radiopharmaceutical was about 3.4 mSv. No further action was necessary.

A pregnant person was exposed to radiation

Incident no.	Description of incident
Incident 232	**A patient who underwent a medical imaging procedure was subsequently found to have been pregnant at the time of the procedure.** A hospital outpatient was referred for a CT lumbar puncture. Before the examination the patient stated that she was not pregnant. The examination was performed without error. The patient subsequently advised the hospital that she was three weeks pregnant at the time of the procedure. The dose to the foetus was about 1.7 mGy. No further action was necessary.
Incident 233	**A patient who underwent a medical imaging procedure was subsequently found to have been pregnant at the time of the procedure.** A patient at a medical imaging practice was referred for an X-ray scan of the whole spine and pelvis. Before the examination the patient stated that she was not pregnant. The examination was performed without error. The patient subsequently advised the hospital that she was in the early stages of pregnancy at the time of the procedure. The dose to the foetus was about 0.94 mGy. No further action was necessary.
Incident 234	**A patient who underwent a medical imaging procedure was subsequently found to have been pregnant at the time of the procedure.** A patient at a medical imaging practice was referred for a CT scan of the region from the liver to pubic symphysis. Before the examination the patient stated that she was not pregnant. The examination was performed without error. The patient subsequently advised the hospital that she was in the early stages of pregnancy at the time of the procedure. The dose to the foetus was about 4.5 mGy. No further action was necessary.
Incident 235	**A patient who underwent a medical imaging procedure was subsequently found to have been pregnant at the time of the procedure.** A hospital patient was administered with 126 MBq of ^{99m}Tc-pertechnetate for a thyroid scan. Before the examination the patient stated that she was not pregnant. Eight days later, the patient returned a positive pregnancy test result. The dose to the foetus was about 1.5 mGy. No further action was necessary.
Incident 235	**A patient who underwent a medical imaging procedure was subsequently found to have been pregnant at the time of the procedure.** A patient presented to a medical imaging practice for a CT scan of the thoracic and lumbar spine due to pain in the lower back. The patient informed the radiographer that she was not pregnant at the time of the scan. The patient subsequently advised the hospital that she was five weeks pregnant at the time of the scan. The dose to the foetus was about 18 mGy. No further action was necessary.

A pregnant person was exposed to radiation (continued)

Incident no.	Description of incident
Incident 236	**A patient who underwent a medical imaging procedure was subsequently found to have been pregnant at the time of the procedure.** A patient attended a medical imaging practice for a CT angiography examination of the aorta, pelvic vessels and lower limbs. At the time of the examination the patient declared she was not pregnant. The CT images revealed that she was pregnant. The patient was about 12 to 13 weeks pregnant at the time of the scan. The dose to the foetus was about 19 mGy. No further action was necessary.
Incident 237	**A patient who underwent a medical imaging procedure was subsequently found to have been pregnant at the time of the procedure.** A patient at a medical imaging practice was injected with 206 MBq ^{99m}Tc-mebrofenin for a hepatobiliary scan. The patient completed the standard patient questionnaire before the scan and indicated she was not pregnant. The patient's GP subsequently notified the nuclear medicine physician to advise that the patient was recently pregnant and may have been pregnant on the day of the scan. The dose to the foetus was about 2.3 mGy. No further action was necessary.
Incident 238	**A patient who underwent a medical imaging procedure was subsequently found to have been pregnant at the time of the procedure.** A patient presented to a medical imaging practice for a CT scan of the lower thoracic and lumbar spine. The patient advised the radiographer that she was not pregnant. Upon reviewing the images, the Chief Radiographer noted a foetus. The estimated gestational age was 20–22 weeks based on foetal bone length measurements. The dose to the foetus was about 17 mGy. No further action was necessary.
Incident 239	**A patient who underwent a medical imaging procedure was subsequently found to have been pregnant at the time of the procedure.** A patient with pelvic pain presented to the emergency department of a hospital for a CT scan of the abdomen and pelvis. The patient advised the radiographer that she was not pregnant. The scan showed a foetus. The dose to the foetus was about 10–12 mGy. No further action was necessary.
Incident 240	**A patient who underwent a medical imaging procedure was subsequently found to have been pregnant at the time of the procedure.** A patient underwent two full body planning CT scans prior to the commencement of total body irradiation (TBI) treatment. At the time of the scans the patient advised that she was not pregnant. Two days later the patient contacted the department to advise of a positive pregnancy test. TBI treatment had not commenced. The dose to the foetus was about 30 mGy. No further action was necessary.
Incident 241	**A patient who underwent a medical imaging procedure was subsequently found to have been pregnant at the time of the procedure.** A patient presented to a medical imaging practice for a contrast enhanced CT scan of the abdomen and pelvis. The patient declared she was not pregnant. On subsequent review of the images, a pregnancy was noted. The dose to the foetus was about 32 mGy. No further action was necessary.

Contamination of persons or articles with a radiopharmaceutical

Incident no.	Description of incident
Incident 242	**A nuclear medicine technologist spilt ^{99m}Tc-pertechnetate in a gamma camera room.** A nuclear medicine technologist (NMT) inadvertently dropped a syringe containing about 1145 MBq of ^{99m}Tc-pertechnetate in a gamma camera scanner room of a hospital. Contamination was detected on the floor and on the NMT's scrub pants and shoes using a radiation survey meter. The total activity spilt was estimated to be 375 MBq. The effective dose to the NMT was less than about 10 µSv. No further action was necessary.
Incident 243	**A nuclear medicine technologist spilt ^{99m}Tc on an injection trolley.** A nuclear medicine technologist spilt 30 MBq of ^{99m}Tc on the plastic cover of an injection trolley. The spill was confined and decontaminated immediately. No skin or other surface contamination occurred. The contaminated cover was properly packaged, labelled and stored in the hot lab for further decay for ten half-lives. The effective dose to all three staff members involved due to the spill or decontamination procedure was less than 10 µSv. The nuclear medicine technologist was counselled and re-educated regarding the drawing up of radiopharmaceuticals.
Incident 244	**A nuclear medicine technologist spilt ^{99m}Tc on a patient.** A nuclear medicine technologist spilt 60 MBq out of 282 MBq of ^{99m}Tc-MIBI on a patient during the stress component of a myocardial perfusion stress, contaminating the patient's clothing. After changing the patient's clothing, the test was completed with no additional administration required. The effective dose to the patient and staff was less than 10 µSv. No further action was necessary.
Incident 245	**A nuclear medicine technologist spilt ^{99m}Tc on a hospital floor.** During a routine cardiac stress test being carried out on a hospital patient, the nuclear medicine registrar accidentally spilled about 10 MBq of ^{99m}Tc-MIBI on an area of the floor in the nuclear medicine department of about one square metre. The floor was subsequently decontaminated and the scan performed with the remaining activity that had not been spilled was diagnostic. The estimated effective doses to the patient and the three staff members involved were all less than about 10 µSv. No further action was necessary.

Finding of potentially radioactive material

Incident no.	Description of incident
Incident 246	**The department was notified of uranium compounds alleged to be stored at a residential site.** The department received a request from Victoria Police to assist in an operation involving the inspection of a residential site. The police had received information that an individual may have been in possession of explosives, chemical precursors to explosives and possibly uranium compounds. An inspection of the individual's premises was conducted by authorised officers of the department with the consent of the individual. No uranium compounds or other radioactive materials were found. No further action was necessary.

Sealed source apparatus lost or missing

Incident no.	Description of incident
Incident 247	**An instrument incorporating a 7.4 GBq ^{85}Kr source temporarily went missing.** The department was notified by a radiation management licence holder that their freight package containing an instrument incorporating a 7.4 GBq ^{85}Kr source had arrived at Melbourne Airport but could not be located. An investigation by authorised officers of the department with assistance from Victoria Police officers, who examined the air consignment notice documentation and tracking records, led to the package being located in the warehouse of an unintended receiver. The break in the chain of transport and custody for the consignment was traced to a subcontracted transport company who had collected the package from a customs-bonded warehouse at Melbourne Airport and delivered it to the wrong address. The Radiation Team conducted inspections of licence holders involved with the missing ^{85}Kr source and met with the transport company that incorrectly delivered the ^{85}Kr source.

Incident involving unsealed radioactive material

Incident no.	Description of incident
Incident 248	**Ilmenite sand was spilled when a truck carrying the ilmenite caught on fire.** A fire developed on a truck transporting a consignment of ilmenite from a mine site to Portland. The fire in the truck is reported to have been caused by brake overheating, which caused some of the truck's tyres to catch fire. The truck pulled over to the side of the road. The fire then caused a rupture in the walls of the carriage containing the ilmenite, resulting in a spillage of an estimated quantity of 3–4 tonnes of ilmenite. Victoria Police and the CFA attended the scene. The CFA extinguished the fire. The ilmenite spilled from the damaged carriage was removed from the road during the night by an excavator with a wedge bucket and placed on another truck. Almost all of the ilmenite spilled from the carriage was recovered overnight. The damaged carriage was moved and the ilmenite lost from the carriage was taken to a nearby mine site for burial at depth. The bulk of the residual ilmenite was removed the following morning and placed into a metal 44-gallon drum. The drum and its contents were subsequently taken to the same mine site for burial at depth. It was not possible to remove all of the ilmenite as some had been burned into the asphalt and some small grains were left after sweeping the road with a broom. The radiation levels measured by authorised officers of the department after clean up were less than three times background radiation levels. The small remaining amount of ilmenite does not pose a risk.

Glossary

Term	Definition
Angiography/ angiogram	The use of X-rays and contrast to image the arteries in the brain, heart, or kidneys.
Extravasation	The leakage of intravenously infused medications into the extravascular tissue around the site of infusion
Extravenous	Existing or taking place outside of, or administered outside of, a vein or veins
Fiducial markers	Markers that provide a method of ensuring accurate target localisation for tumours or organs for radiotherapy
Gamma camera	A device that detects the radiation from radiopharmaceuticals that have been administered to a patient in order to diagnose a medical condition
Intravenous (IV)	Existing or taking place within, or administered into, a vein or veins
PACS	Picture archival and communication system
p-value	A p-value measures the probability that obtaining the observed difference in results is due to chance alone. The lower the p-value, the greater the statistical significance of the observed difference, i.e. the lower the p value, the more likely there is a true correlation between variables. A p-value of 0.05 or lower is generally considered statistically significant.