



## ***AUSTRALIAN RADIATION INCIDENT REGISTER (ARIR)***

### **SUMMARY OF RADIATION INCIDENTS: 1 JANUARY TO 31 DECEMBER 2010**

The total number of radiation incidents reported to the Register that occurred during the period from 1 January to 31 December 2010 was **116** (as at 1 July 2011). A summary of the incidents in each category is given below:

#### **Diagnostic Radiology: 57 Incidents**

*27 incidents involved patients being given unnecessary/unplanned CT scans/radiology examinations due to mistaken identity.* In fourteen of these cases, the mistaken identity was due to the incorrect identification of a patient by radiology staff. This was related to procedural errors, not asking open-ended questions, or confusing patients with similar names, dates of birth or clinical histories. In another thirteen cases, the wrong patient was selected from the electronic booking system or the wrong patient label was placed on the referral form due to: human error, not following procedures or protocols, or confusing patients with similar clinical histories. Across all cases, patients received unintended doses ranging from 0.3  $\mu$ Sv to 21 mSv.

*8 incidents involving an unnecessary repeat CT scan given to the patient.* Six of these cases involved duplicate requests due to communication errors and inadequate shift-handover or forms being sent on two different days. Patients received unnecessary dose of between 1.35 mSv and 16 mSv. In another case, staff failed to cancel the request following patient review. This resulted in the patient receiving an unnecessary dose of 15mSv. The last case involved a diagnostic procedure being performed before the specific date requested resulting in a second request being issued - giving an estimated effective dose of 25.9 mSv.

*8 incidents involved a CT scan or X-ray of a patient later found to be pregnant.* In 7 cases, the patient was not aware of being pregnant or replied that she was not pregnant when asked at the time. The last case saw the diagnostic procedure being administered to the wrong patient who was pregnant and the fetus received 0.01mSv. Across all other cases, doses to the fetus ranged from 0.22 mSv up to 20 mSv.

*7 incidents involved unnecessary CT scan/radiology examinations.* In four cases, the patient received diagnostic examinations in addition to those requested e.g. a CT scan with contrast in addition to the plain CT. Across the four cases, the patient received an extra dose of between 2.8 mSv and 4 mSv. In another two cases, the wrong procedure was performed. These cases resulted in an unnecessary dose to the patient of 12 mSv and 1.3 mSv. In the final case, a diagnostic procedure was performed that was no longer required – dose to the patient was 3.5 mSv.

*3 incidents involved CT scans/radiology examinations performed on the wrong region of the patient.* The incidents resulted in an extra dose of 22mSv, 21mSv and 3.7mSv to the patient, respectively.

*3 incidents involved a patient receiving a higher than normal radiation dose during an interventional procedure.* In the first of these cases, staff mistakenly engaged fluorography rather than fluoroscopy mode. The second case, the patient underwent a particularly prolonged procedure and in the third case, the operator did not adjust controls from the warm-up settings. Patient doses ranged from 0.6 to 11.9 mSv.

*1 incident involved unintended radiation exposure.* A hospital worker received a very low unintended radiation dose after entering the CT scanning room while the CT was in warm-up mode despite the 'in use' sign. Procedures were amended to require the operator to remain in the control room whenever the scanner is in operation.

*Root causes for these incidents included:* human error; not following policy/procedures, not considering the Correct Procedure, Correct Patient, Correct Site (known as the 3Cs); not asking the patient open questions; not confirming patient information, such as date of birth; similarity in patient names; faxing duplicate requests; miscommunication between staff or between staff and patients; patient language difficulties; unknown pregnancy status; incomplete information in the ordering system; staff being under pressure during a busy period; selecting the wrong patient from the electronic ordering system; not following requirements in the request; misinterpreting requests; placing the incorrect patient label on the request form; confusion between patients having similar symptoms, absence of adequate security.

*Actions taken to prevent recurrence of a similar incident included:* requiring two staff to duplicate time-out procedures; reminding staff to follow procedures, perform checks, and maintain vigilance; posting reminder notes and signs within the department; holding meetings and forums to reiterate procedures and discuss whether new methods or procedures are necessary; adding more fields to the request system; modifying work instructions, procedures or software; signalling on a request form that a duplicate has been made; implementing audits; removing copies and using only originals; requiring staff to undergo training; and investigating current procedures to determine adequacy.

## **Nuclear Medicine: 28 Incidents**

*10 incidents involved the wrong scanning agent/radiopharmaceutical being given to the patient.* Four of these incidents involved staff not correctly checking labels on lead pots, vials or drawn up doses. The doses administered were between 1.85 mSv and 18 mSv. In another five cases, the incorrect reconstitution of the radiopharmaceutical kit was prepared due to the wrong radiopharmaceutical vial being used. Doses to the patient were estimated to be between 1.92 mSv and 11 mSv. In another case, a failure to read the request resulted in a patient receiving a bone scan despite requiring a radiological skeletal survey. The dose to the patient was estimated to be approximately 4.6 mSv.

*9 incidents involved the administered radiopharmaceutical not being able to be used for diagnosis.* In five of these cases, the radiopharmaceutical was inadvertently injected into the tissues rather than a blood vessel and the procedure needed to be repeated because images failed to show diagnostic information. Patients received an unnecessary dose of between 5 and 8mSv. In another case, a patient was administered a dose for the purposes of an exercise study but was not exercised because the patient had not been adequately prepared thus resulting in an effective dose of 8.1 mSv. A faulty injection pump failed to properly inject radiopharmaceutical rendering the images un-diagnostic and resulting in an estimated effective dose to two patients of 8.5 mSv each. Another case saw the injected radiopharmaceutical not distributing as required due to incorrect preparation by the supply company. The effective dose to the patient was estimated to be 3.36 mSv. In the last case, there was a delay between the patient being injected and undergoing the scan resulting in radiopharmaceutical decay below levels where a scan would yield necessary diagnostic information. The estimated effective dose to the patient was estimated to be 13.6 mSv.

*3 incidents involved unnecessary dose being administered to the patient.* In the first of these cases, the patient inhaled three times the required activity of 40 MBq of Technegas resulting in an extra effective dose to the patient of 1.5 mSv. Two cases, saw the dose administered being higher than required due to staff not checking the label and setting incorrect radionuclide on the dose calibrator. Estimated effective dose to patients of 5.16 mSv and 14 mSv.

*2 incidents involved the radiopharmaceutical being administered to the wrong patient.* In one of these cases, the wrong patient was selected using the electronic ordering system resulting in an estimated effective dose to the patient of 1.5mSv. In the other case, the referring clinician identified the wrong patient on the request for medical imaging. Resultant doses unnecessary to the patients were 2.1 mSv and 11 mSv.

*2 incidents involved a spill of radiopharmaceutical.* In one of these cases, the bulk vial of Fluorine-18 slipped out of the handing forceps smashing on the hot lab floor. Only a minimal dose was received because the staff member quickly exited the room after the spill and received no contamination on their clothing. In another case, an inadvertently uncapped patient cannula resulted in a spill of Technetium-99m MDP. Thorough decontamination of the patient, surrounds and appropriate disposal of waste were performed immediately after the incident resulting in only minor skin and external radiation doses.

*2 incidents involved nuclear medicine examinations of a patient later found to be pregnant.* In both of these cases, the patient was administered with Technetium-99m and was unaware of her pregnancy, denying being pregnant when asked. The dose to the fetus was less than 1 mSv for the first incident and 27 mSv for the second patient because she also had a whole body CT as part of staging for aggressive cancer.

Root causes for these incidents included: not following procedures or protocols such as colour-coding procedures; misreading or not reading labels properly; patients inhaling more radionuclide than necessary; patients being unaware of their pregnancy status; faulty equipment; staff having large workload, performing repetitive work and being complacent; radiopharmaceutical supply company errors; and incorrect cannula placement and uncapped lumen placement.

Actions taken to prevent recurrence of a similar incident included: highlighting incidents and errors at staff meetings; reviewing and revising protocols, policies and procedures; ensuring the radionuclide activity is measured after each patient breath and that the syringe is moving; purchasing new equipment; ensuring patients are asked about their pregnancy status; stressing staff maintain vigilance and attention; modifying orientation procedures for Registrars; retraining of staff in procedures such as cannula placement; adding checklist items to software and written procedures; and researching new Quality Control (QC) methods.

## **Radiotherapy: 11 Incidents**

*6 incidents involved the wrong area being treated using a linear accelerator.* In the first of these cases, a patient received approximately 3 Gy to normal tissue due to confusion between a routine override and an edit that occurred as part of the first day setup. Another case saw the incorrect area being treated for 19 of 20 prescribed fractions due to insufficient information and communication between specialists. One case saw 8 Gy being delivered 2 cm superiorly to the intended treatment location due to incorrect interpretation of the pre-treatment image. Another case saw 2 Gy being delivered approximately 13 cm superior to the planned area due to the patient not being moved back to the correct position after being moved to allow the gantry movement when changing to opposing fields. In the next case, the isocentre was incorrectly labelled on the treatment sheet resulting in two fractions being delivered to a centre 9 cm away. In another case, a patient received treatments on both upper and lower right sides due to the prescription not accurately conveying that only the upper right side was required. This resulted in an unnecessary treatment dose to the extra area of neck of approximately 2 Gy.

*2 incidents involved an extra unnecessary dose being received by the patient.* In the first case, miscommunication between staff and the patient resulted in a dose to the bladder although the Oncologist had decided against the treatment. Another case involved a patient being administered with the same treatment plan as the previous patient because the treatment data was

not re-downloaded. Because the patient ID protocol was not followed and a second staff member failed to check the records as per the ID protocol, the patient received an estimated dose of 3 Gy.

*1 incident the wrong patient being given radiotherapy treatment.* This case saw the incorrect patient receiving an additional dose of 1 Gy due to confusion between 2 patients both requiring treatment of the prostate and staff members not adhering to departmental patient identity procedures.

*1 incident the patient being given the wrong planning CT scan.* In this case, the incorrect booking form was used resulting in the patient receiving a treatment planning scan of the wrong body part with a dose of 11 mSv.

*1 incident involved a higher dose being received due to a software error.* Seven patients received greater doses than intended (by 10%) because the software used to plan radiation treatment when a split beam is required had an error that did not make it apparent that higher doses were being delivered.

Root causes for these incidents included: operators not following procedures; failure to identify mismatch between the computer system, treatment sheet and patient ID; failure to check records; transcription errors; miscommunication during shift-changeovers; poor communication between staff; poor design of patient information sheet; insufficient information; and software malfunctions.

Actions taken to prevent recurrence of a similar incident included: issuing memos to stress vigilance and strict adherence to procedures; revising policies or documentation (treatment sheets) to include more fields or require more information; implementing an action plan to improve communication within the radiotherapy department; retraining staff; revising procedures to include extra steps; highlighting incidents and errors at staff meetings; and introducing a new patient information system.

### **Borehole Logging: 5 Incidents**

*2 incidents involved borehole logging sources lost in holes and later recovered.* In the first of these cases, one borehole logging source became detached from its wire-line. Later fishing tests were successful in recovering the source and bull plug, and wipe tests confirmed the source was undamaged. Another borehole logging source containing Cobalt-60 became stuck down a hole before it was eventually recovered intact with the drill string.

*2 incidents involved logging tools becoming stuck in holes and needing to be abandoned.* Two radiation sources on logging tools (both containing Caesium-137 and Americium-241-Be) became lodged in drill-holes with cables still attached. In both cases, fishing attempts were unsuccessful and the tool was deemed unrecoverable and cemented in situ.

*1 incident involved a borehole logging tool being stuck in a collapsed well.* A logging source was abandoned after unsuccessful fishing operations.

### **Sources Lost: 3 Incidents**

In the first of these cases, a 37 MBq vial of Phosphorus-33 dTTP was ordered and received appropriately. The empty vial was later found but the radioactive contents were not recorded as being used at the facility. In another case, 2 unsealed sources (1.7 and 3.3 MBq of Europium-152 and Strontium-90 respectively) were found missing following a routine audit. Another case saw 11.6 kBq of Cobalt-60 noticed as missing and not found despite extensive searches and investigations.

*Root causes for these incidents included:* changes in management; complex tracking system; spread of activities over different locations; poor record keeping and quality management; and not following tracking system procedures.

*Actions taken to prevent recurrence of similar incidents included:* improved security by adding locks; regular reviews and audits of security practices; and recordkeeping training introduced.

### **Radiation Gauge: 2 Incidents**

*1 incident involved an exposure to workers where the gauge had not been isolated.* A mining company reported that workers received doses of 8.75 - 21  $\mu\text{Sv}$  when performing maintenance on a primary crusher. Reports found they entered from a level different to that expected where they were not appropriately isolated from the gauge. There was an inadequate permit system for staff entering the site and procedures have since been amended.

*1 incident involved leaking of a sealed source within a radiation gauge.* While the gauge was being tested for compliance with radiation safety standards, it was found that the gauge was leaking resulting in 2 workers and surrounding area being contaminated. The environmental conditions in the area surrounding the gauge were relatively harsh.

### **High Recorded Dose: 2 Incidents**

*1 incident involved an unexplained high dose on a control radiation monitor.* An unexplained high dose of 53 mSv was recorded on the control monitor used as a reference for personal dosimeters used by workers. Personal dosimeters provided readings within the expected range. Further investigations could not find the source of the high recorded dose.

*1 incident involved a high dose on a personal radiation dosimeter.* A personal dosimeter returned a dose of 95mSv after falling off its holder and remaining in the radiotherapy treatment room during patient treatment. To ensure similar incidents are identified sooner, radiation safety protocols were amended so that personal radiation monitoring incidents are reported to the organisation's RSO within a week.

### **Deliberate or Malevolent Act: 2 Incidents**

A veterinary radiographer found two images of a human skull stored on the CT unit taken at approximately 23:00 hours. The images were very poor quality and appeared to be consistent with images taken by an unskilled operator. In response, security of the CT scanning room has been tightened. The estimated effective dose to the person was 3mSv.

In another incident it was reported that a person may have swallowed some Am-241 smoke detector sources whilst intoxicated. It is noted that 'prank' type incidents such as this are difficult to anticipate or control.

### **Cabinet X-ray: 1 Incident**

*1 incident involved a child crawling up the conveyor*

A child crawled up the conveyor belt leading towards the tunnel of a baggage X-ray. The child did not pass through the tunnel and it is unlikely that he/she would have received more than minimal scatter radiation before the machine was stopped by the operator.

*To prevent recurrence of a similar incident* staff were requested to be vigilant when processing passengers.

### **Industrial Radiography: 1 Incident**

A worker was exposed to a industrial radiography source when the worker walked up to the area without having properly wound up the isotope in the camera, checked his survey meter or checked the safety lock on the camera. The worker's electronic dosimeter was not activated because it was covered by many layers of clothing. The worker received an estimated exposure of 9.7 mSv.

*The root cause of this incident was that the operator failed to check safety equipment and that the isotope was in a safe position. To prevent recurrence of a similar incident there will be additional training for industrial radiographers and assistants on the need for safety and care when using radiation equipment.*

### **Laboratory: 1 Incident**

An incident was reported where 100 MBq of Technetium-99m was taken off site for a training exercise without authorisation. Investigations found that the staff thought the source was below exemption levels. No radiological consequences ensued.

*The root cause of this incident was that operators believed the material was below exemption levels. To prevent recurrence of a similar incident a new form has been introduced to ensure that appropriate personnel are notified when controlled material is to be used in field exercises.*

### **Portable Density/Moisture Gauge (PDMG): 1 Incident**

*1 incident involved a truck running over a density moisture gauge (PDMG). A driver was instructed to reverse the truck into an area where a PDMG was being used. The PDMG was subsequently hit and dragged a few metres resulting in only the plastic shell being slightly damaged.*

*The root cause of this incident was that other workers were unaware that soil testing was being conducted. To prevent recurrence of a similar incident, procedures will be introduced to make workers aware when soil testing is taking place and staff using gauges will be encouraged to conduct testing in less trafficable areas.*

### **Transport: 1 Incident**

A motor vehicle crash resulted in release of nuclear medicine radioactive material. The site was cordoned off and radiation safety staff attended. Post-incident, staff were monitored for contamination and the area cleaned up. Debris and contamination was removed and placed in bags and containers and disposed or stored appropriately. Due to the small area of contamination and the short-half life of radioactive substance there was no risk to persons or the environment.

### **Unauthorised Disposal of Source: 1 Incident**

A non-functioning spectrometer was sold to an auction house which subsequently on-sold it. The incident was reported to the radiation regulator and the originating organisation implemented staff training and reviewed procedures.