Australian Government

Australian Radiation Protection and Nuclear Safety Agency

ARPANSA

Protecting people and the environment from the harmful effects of radiation

AUSTRALIAN RADIATION INCIDENT REGISTER

Summary of Radiation Incidents

1 January 2015 to 31 December 2015

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1. Introduction

Radiation is routinely used across Australia by thousands of individuals, performing millions of tasks. The incidents which occur and the nature of the resulting outcomes, show that the use of radiation in Australia is generally very safe. However, unexpected events will occasionally occur and the reporting of these incidents can help to prevent future occurrences by creating learning and awareness among users and regulators.

The Australian Radiation Incident Register (ARIR) is a repository of radiation incident information from Commonwealth, state and territory radiation regulators. It is intended to raise awareness of radiation safety and to facilitate the sharing of lessons learnt from incidents across Australia.

Schedule 13 of Radiation Protection Series No.6 (RPS6), *National Directory for Radiation Protection (NDRP)* specifies the types of incidents that must be reported to ARPANSA for compilation in the ARIR. Reporting arrangements are agreed by the ARPANSA Radiation Health Committee (RHC) which includes representatives from radiation regulators of each Australian jurisdiction.

Further information on the ARIR can be found on the ARPANSA website.

2. Purpose and Scope

This report is a summary and analysis of data submitted to the ARIR for incidents which occurred in 2015.

The purpose of this report is to identify topical areas in which safety effort may be directed to improve radiation protection. Therefore, the focus of this report is the causes of incidents and remedial actions taken.

Geographical or personal data that may lead to the identification of individuals or organisations is not included in an incident report and does not form part of this analysis.

3. Overall Statistics

3.1 Number of incidents reported

The number of incidents reported continues to increase. In 2015 there were 346 incidents reported, which represents an increase of 18% over the number of incidents reported in 2014. ARPANSA has been actively raising awareness of the incident register since 2012. This includes the clarification of reporting requirements in the NDRP in 2013.

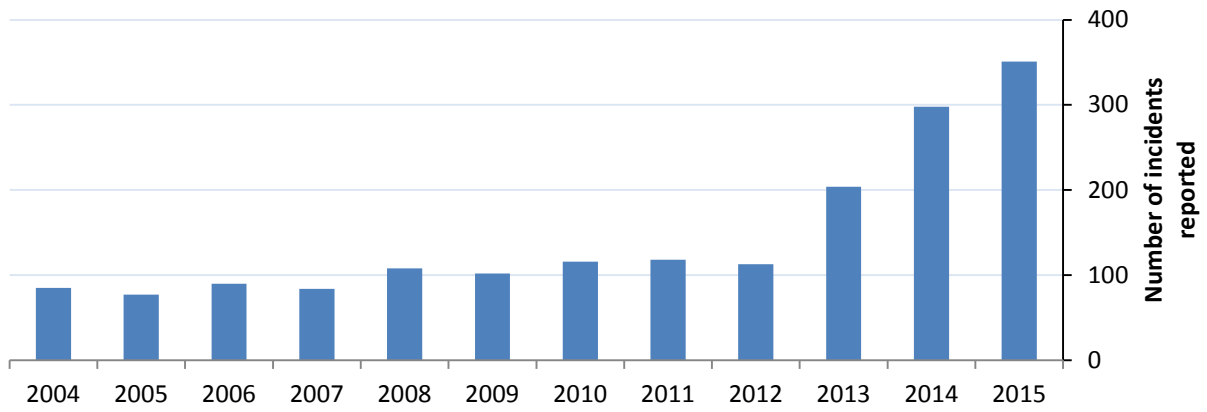

Figure 1 – Number of incidents reported to the register over time

3.2 Types of incidents reported

Table 1 provides the number of incidents by category over the last five years. The category with the majority of incidents (almost 70%) continues to be diagnostic radiology. This is expected as diagnostic radiology, which includes medical imaging procedures such as general X-rays and CT scans, represents one of the largest areas of radiation use in Australia. For example, Medicare MBS billing information shows that more than 2.5 million CT scans were carried out in 2015. This number does not take account of any CT scans that were not covered by Medicare.

Table 1: Overall ARIR statistics for 2015 compared with previous four years (note percentages rounded)

	2015		2014		2013		2012		2011	
Incident Category	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Diagnostic Radiology	235	67%	175	59%	112	55%	65	58%	57	48%
Nuclear Medicine	84	24%	74	25%	52	25%	28	25%	33	28%
Radiotherapy	8	2%	14	5%	9	4%	6	5%	10	8%
Laser	4	1%	1	<1%	1	<1%	2	2%	1	<1%
Borehole Logging	3	<1%	5	2%	6	3%	1	1%	4	3%
Portable Density/Moisture Gauge	2	<1%	1	<1%	2	1%	0	<1%	3	3%
Contamination	1	<1%	4	1%	3	1%	2	2%	0	<1%
Dental	1	<1%	3	1%	2	1%	1	1%	0	<1%
External Exposure (non-medical)	1	<1%	3	1%	4	2%	2	2%	0	<1%
High Recorded Dose	1	<1%	2	<1%	1	<1%	0	<1%	1	<1%
Industrial Radiography	1	<1%	6	2%	1	<1%	0	<1%	2	2%
Laboratory	1	<1%	2	<1%	2	1%	1	<1%	0	<1%
Radiation Gauge	1	<1%	3	1%	1	<1%	0	<1%	1	<1%
Sources Lost	1	<1%	0	<1%	0	<1%	1	<1%	2	2%
Theft of Sources	1	<1%	2	<1%	1	<1%	0	<1%	1	<1%
Transport	1	<1%	1	<1%	3	1%	1	<1%	1	<1%
Other	2	<1%	2	<1%	4	2%	3	3%	2	2%
TOTAL	346		298		204		113		118	

3.3 Source of incident reports

Incidents are reported by state and territory regulators, based on reports received from users of radiation in their jurisdiction. While the specific requirements for incident reporting vary between jurisdictions, the NDRP outlines the common requirements for reporting of incidents to the ARIR. However, due to differences in legislation and differing levels in the promotion of incident reporting, some jurisdictions report more than others.

4. Causes of Incidents

4.1 Primary cause

Figure 2 shows the primary causes of incidents reported in 2015. Human error was identified as the primary cause for 261 incidents (74%) which is consistent with previous years.

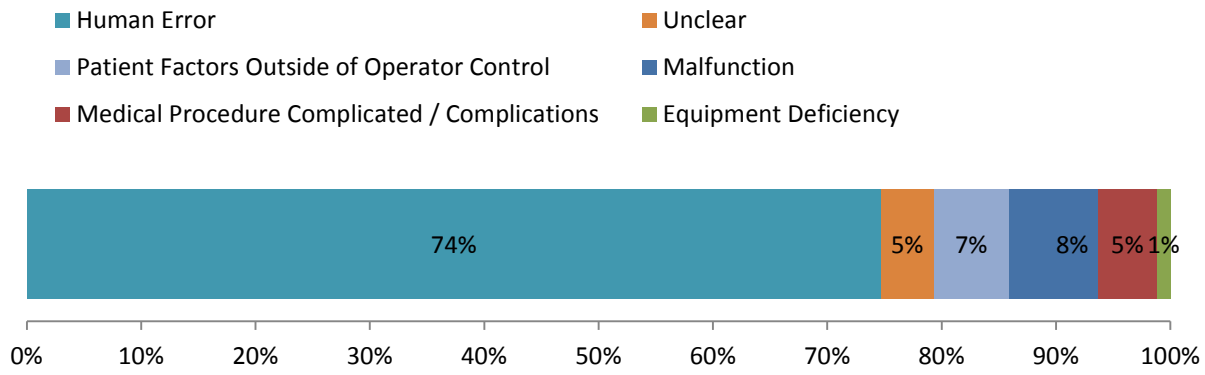

Figure 2 – Incidents by primary cause

4.2 Contributing causes

An incident will usually have a number of underlying contributing causes. However, the report does not always identify these factors. Figure 3 shows the contributing causes of incidents reported in 2015. Contributing causes could not be identified for 14% of incidents. In some instances such as medical complications during a procedure, the causes may not be readily apparent, for other reports insufficient information was provided.

The most common contributing cause was ‘individuals not following procedures’ which was identified in 25% of incidents. For medical incidents the second biggest factor was ‘errors in orders/interpretation of orders’ which contributed to 23% of medical incidents; ‘equipment limitations’ contributed in 17% of non-medical incidents.

Incidents typically had multiple contributing causes and it is quite possible that they would not have occurred if one of the contributing causes had been prevented. This is the basis for the ‘Swiss Cheese’ model of safety, where an incident or accident occurs only where there is an alignment of vulnerabilities. This demonstrates the value of the ‘defence in depth’ approach to radiation safety where a number of independent controls prevent or mitigate errors and safety problems. Often small changes can block a pathway leading to an incident which can significantly reduce the likelihood of the incident occurring.

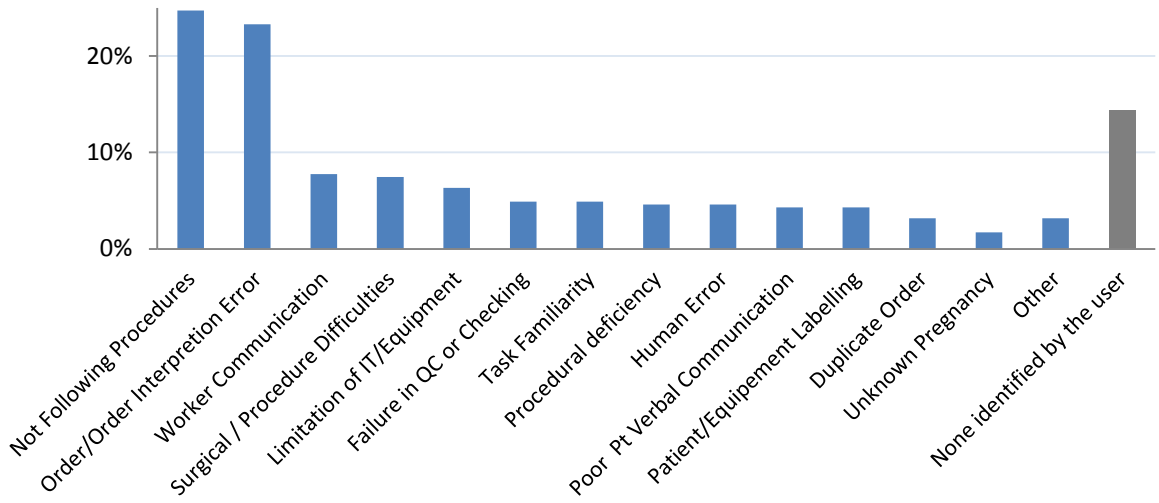

Figure 3 – Contributing causes identified in 2015 incidents

5. Summary of Controls and Preventive Measures Implemented

Preventive measures are the actions taken as a result of an incident to prevent recurrence. Figure 4 shows the types of remedial actions taken in 2015 to prevent recurrence. One or more remedial actions were identified in almost 80% of reports.

Reinforcement of procedures and reminders of good practice remain the most common actions taken after an incident. In 2015 this measure was applied to 42% of incidents, a moderate increase from previous years of 33% in 2014 and 41% in 2013.

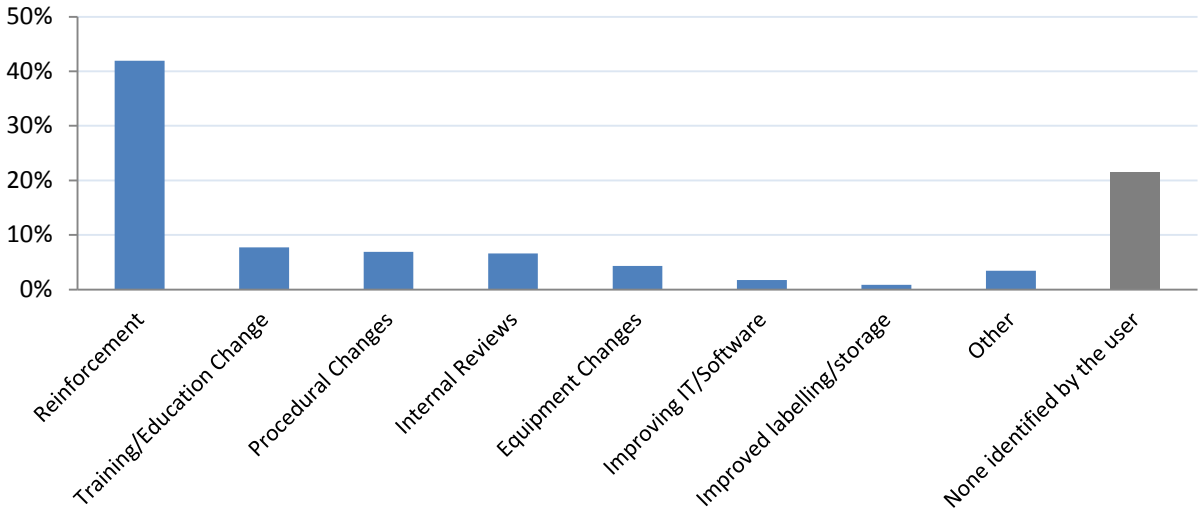

Figure 4 – Remedial actions taken to prevent recurrence in 2015

6. Summary of Common Incidents by Cause

6.1 Human error

Approximately 75% of all incidents reported human error as the primary cause.

For incidents where human error was identified as the primary cause, the most common identified contributing causes were individuals not following procedures (31%), errors in orders or in the interpretation of order instructions (30%) and worker communication (11%). The root cause of the contributing causes was rarely reported.

Where human error was the primary cause, preventive measures included reinforcement or reminder of correct procedure/good practice (54%), further training or education (9%), internal reviews (8%), procedural changes (8%), and equipment changes (3%). No preventive measures were identified from 12% of the reports submitted.

Human factors improvements were implemented after some incidents. Many of these were relatively simple. Examples include improved labelling and storage of sources, and improvements in communications protocols and procedures.

6.2 Equipment error/malfunction

Equipment failure includes situations such as software failure, for example on a CT scanner, where a procedure had to be repeated with a resultant increase in patient dose. Also included were failures of hardware or components critical to safety, such as damage to a laser fibre optic cable or a faulty injector.

Of the 27 incidents which identified equipment failure as the primary cause, there were no trends or common modes of failure. This suggests that the faults were not due to systemic issues, such as the supply of products with manufacturing defects which could be subject to a recall.

7. Summary of Common Incidents by Category

7.1 Diagnostic radiology: 234 incidents

Diagnostic radiology includes general X-rays, CT scans, fluoroscopic, and interventional procedures.

In 2015, diagnostic radiology incidents included:

- unnecessary scans (35%), including repeat scans and duplicate orders
- imaging the wrong region (21%), for example imaging the left leg instead of the right leg
- imaging the wrong patient (20%)
- imaging where the patient was later found to be pregnant (7%).

7.1.1 Unnecessary scans

Order errors, including duplicate orders, were responsible for 40% of unnecessary scans. Of the 11 incidents which involved duplicate orders, half of them involved the use of faxes either sent to multiple locations or used in parallel with an alternative request system. Several practices identified procedural or technological changes to the ordering system which could reduce the frequency of these events. Two practices identified the removal of all faxed requests, or using digital requests only, as a preventive measure they would be implementing to mitigate this issue.

7.1.2 Wrong patient/region

Imaging the wrong region or patient occurred in 41% of diagnostic radiology incidents. Of these, 40% were identified as due to errors being made in the order, or the interpretation of the order. Not all of the remaining incidents could be categorised by cause, however many of the incidents involved individuals not following correct patient identification procedures.

Remedial actions and preventive measures implemented focused on individual performance or reinforcing the importance of procedures among staff/team members. These controls are often not effective in the long term as they rely on the awareness of individuals rather than addressing the underlying contributing factors at an organisational level.

7.2 Nuclear medicine: 84 incidents

Nuclear medicine includes all procedures involving the administration of radiopharmaceuticals. This includes diagnostic imaging procedures such as Single Photon Emission Computed Tomography (SPECT) or Positron Emission Tomography (PET) and therapeutic procedures such as I-131 therapy for hyperthyroidism.

In 2015, reported nuclear medicine incidents included:

- the administration of the incorrect scanning agent or radiopharmaceutical (18%). Almost half of these incidents identified labelling to be a contributing cause
- patients later found to be pregnant (7%). In all cases the patient informed staff that they were not pregnant prior to the scan being performed.

Important factors identified as a result of these incidents include:

- worker communication, particularly where a task is commenced by one staff member and completed by another
- labelling, including matching incoming orders and when drawing up doses/using the dose calibrator
- confirming connections to the patient's cannula are secure.

7.3 Radiotherapy: 8 incidents

Six of the radiotherapy incidents involved misalignment of the treatment area resulting in the incorrect region being exposed to additional radiation. The remaining incidents involved an increased dose delivered to the target area.

Important factors identified as a result of these incidents include the importance of quality checks such as routine visual checks of treatment field shapes during radiation delivery, robust and consistent anatomical landmarking, communication, and the availability of staff with sufficient experience and training.

Reinforcement and education were identified as the remedial action taken in response to more than half of the incidents; equipment and procedure changes were also implemented in some cases.

7.4 Non-medical: 12 incidents

Non-medical incidents included:

- three incidents involving borehole logging sources which became stuck down the borehole; one of which was retrieved, the other two sources could not be recovered.
- three incidents involving portable density gauges: one of which was struck by a vehicle while in operation, one where a gauge came lose in a transport vehicle but was not damaged, and one where a vehicle and the gauge it was transporting were stolen
- two incidents involving higher than expected dosimeter readings, both of which were the result of leaving the badge in a high dose area while not being worn
- one incident involving damage to a transport package where the source being transported remained undamaged

  one incident involving a maintenance worker who had come into contact with surface contamination which was detected and removed before the worker left the controlled area.

7.5 Laser and non-ionising radiation: 4 incidents

The incidents reported only related to regulated activities. As most Australian jurisdictions do not regulate the use of lasers, or only regulate the use of medical or cosmetic laser products, reported incidents may not be representative of all laser incidents in Australia.

Three of the incidents concerned medical lasers, two of which were related to equipment failure, and one where the user failed to wear the required personal protective equipment. The remaining incident related to a cosmetic laser.

8. Conclusion

There are more than 40,000 licence holders using radiation across Australia, many of whom work in medicine. Unexpected events are likely to occur even with strict controls in place. Where these events involve radiation and meet the requirements of the National Directory for Radiation Protection they are required to be reported to ARIR. The incidents that are reported are analysed to look for trends, raise awareness of common hazards or mistakes, and identify practices which can prevent future incidents. The incidents which occur and the nature of the resulting outcomes, show that radiation use in Australia is generally very safe. However, analysis of the causes and preventive measures applied shows that common learnings can be identified which could help to prevent similar incidents.

The number of incidents reported in 2015 increased by about 18% from the previous year. Recent increases are considered to be due to an increase in reporting rates resulting from ARPANSA's active promotion of the register and the benefits of reporting all incidents. It is likely that further increases in report numbers are possible in subsequent years as reporting practice continues to improve.

Human error was the primary cause identified in the majority of incidents reported in 2015, which is consistent with previous years. Analysis of contributing causes and preventive measures suggests that there is high reliance on actions taken by individuals, rather than other organisational or technological systems (e.g. processes, procedures, physical or engineering controls). While a reliance on administrative controls is to be expected for many of the uses of radiation, the information in incident reports suggests that many of the contributing causes could be identified prior to the incident. In the majority of cases, similar incidents have been previously reported to the ARIR. Examples include: failures in quality control processes such as cross checking of information, problems with procedure adherence, problems with labelling and ordering systems, and more general communication issues.

Reinforcement of correct processes or practices, and training and education were the most common preventive measures identified in 2015 reports. These controls may not be effective in the long term as they rely on the awareness of individuals, rather than addressing underlying contributing factors such as procedures and workflows or technological solutions.