



Australian Government
Australian Radiation Protection
and Nuclear Safety Agency



Australian Clinical Dosimetry Service

CAG Report

2024



Letter of transmittal

12 September 2025
Dr Gillan Hirth AO
Chief Executive Officer
Australian Radiation Protection and Nuclear Safety Agency
619 Lower Plenty Road
Yallambie VIC 3085

Dear Dr Hirth

As agreed in the Terms of Reference for the ACDS Clinical Advisory Group 2023-2025, please find enclosed the Report of the ACDS Clinical Advisory Group 2023-24 that has been prepared in conjunction with the ACDS Year in Review Report 2023-24.

This report has been compiled by and is endorsed by the ACDS Clinical Advisory Group membership of:

- Dr Lucinda Morris
- Dr Louise Nardone
- Mr Adam Briggs
- Dr Andrew Cousins
- Dr Katrina Woodford
- Ms Rebecca Thyne
- Prof. Joerg Lehmann
- Prof. Tomas Kron.

Yours sincerely

Dr Lucinda Morris
Chair of ACDS Clinical Advisory Group

Introduction

Since 2011, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) has operated the Australian Clinical Dosimetry Service (ACDS), a world-class independent dosimetry auditing program dedicated to ensuring high standards of quality assurance and patient safety in radiation therapy across Australia and New Zealand. The ACDS Clinical Advisory Group (CAG) serves as an advisory body, offering clinical and scientific guidance on various aspects of the ACDS program. This includes addressing out-of-tolerance audit findings, developing audit methods and phantoms and refining the audit suite. The CAG also reviews and provides feedback on the ACDS's performance metrics.

Membership includes representatives from key professional bodies, selected on the bases of their expertise and experience:

- Radiation Oncologists – The Royal Australian and New Zealand College of Radiologists (RANZCR)
- Medical Physicists – Australasian College of Physical Scientists and Engineers in Medicine (ACPSEM)
- Radiation Therapists – Australian Society of Medical Imaging and Radiation Therapy/ New Zealand Institute of Medical Radiation Technology (ASMIRT/NZIMRT)
- Clinical Trials Experts – Trans-Tasman Radiation Oncology Group (TROG).

The CAG is chaired by a radiation oncologist and regular meetings are convened quarterly. Additional sessions are held as needed to address urgent audit concerns.

Further details about the CAG can be found at arpansa.gov.au/cag.

How audit findings have directly impacted patient care

Radiation therapy is a vital and effective cancer treatment, contributing to 40% of cancer cures and benefiting over half of all cancer patients during their treatment journey (Delaney et al. 2005). Over the last decade, advances in planning and treatment delivery technology have vastly improved the precision and effectiveness of radiation therapy and the ability to accurately deliver high doses. As a result, the importance of consistently delivering the correct dose to the correct anatomical location has never been more critical for patient safety.

Radiation therapy dosimetry audits conducted by the ACDS play a key role in ensuring that high quality safety standards are maintained for cancer patients undergoing radiation therapy across Australia and New Zealand. The ACDS collaborates with facilities to resolve dosimetry issues, support the adoption of new techniques, and provide reassurance through independent quality checks. The ACDS is independent and collaborates with multiple international auditing bodies; officially being recognised as a peer amongst these global auditing programs.

ACDS audit breakdown 2023–24:

- Number of audits during the 2023-24 financial year = 99 (46 remote, 53 onsite)
- Level I: 46 (including 9 follow-ups and 1 field trial)
- Level Ib: 16
- Level II: 7
- Level III: 14
- Level Ib kV: 3
- Level III SRS: 2
- Onsite follow-ups: 8
- Onsite field trials: 1
- Out-of-schedule Level IIIs: 2.

The CAG review the 'out of tolerance' results, initially out of session and then in more depth at regular meetings. In this reporting year there were 8 new cases from 6 different facilities. In 4 of these cases, the CAG recommended follow-up measurements which resolved the 'out of tolerance' results. At the end of the 2023–24 financial year, the other 4 cases remained under investigation as discussions between the ACDS, the CAG and the facilities continue. The number of new 'out of tolerance' cases is a notable reduction compared to the 2 preceding financial years (51 cases in 2021–22 and 2022–23 combined). Causality was assigned to 2 'out of tolerance' cases and attributed to sub-optimal beam model optimisation.

The CAG has also reviewed 6 cases from previous years and assigned 3 of these as non-clinical cases and closed the other 3 following follow-up measurements. The ACDS follow-up included a repeat delivery of the same plan, producing a pass result. Of note is the additional uncertainty of repeat measurements, especially when the follow-up audit is performed a number of months after the original.

The CAG can assign a case as non-clinical if, for example, a particular energy, say 10 MV FFF, or a particular technique, say spine SABR, is not in clinical use in that facility but part of the suite of cases presented to the ACDS by the facility in an audit. With the release of new Treatment Planning System (TPS) versions sometimes the multi-leaf collimator (MLC) modelling needs revising, and this has shown up in some 'out of tolerance' audit results. Due to the experience of the ACDS and the CAG, we have been able to provide advice in these cases to resolve the 'out of tolerance' results before the new TPS has been clinically released in that facility, preventing potentially sub-optimal patient treatments.

Quality assurance in clinical trials

Clinical trials play a vital role in advancing cancer treatment, including in radiation oncology. They enable the testing, development and safe implementation of new treatment technologies and techniques. A critical element of these trials is quality assurance (QA), which ensures participant safety, the effectiveness of interventions, and the reliability of trial outcomes. As part of the QA process, centres involved in radiation therapy clinical trials must demonstrate their ability to accurately deliver trial-specific radiation treatments.

Dosimetry audits by the ACDS are integral in the clinical trials conducted by the Trans-Tasman Radiation Oncology Group (TROG). These audits provide independent, rigorous evaluation of modern radiation therapy techniques, ensuring the accuracy and safety of the TROG clinical trials.

We also recognise the continued guidance and expertise provided by the TROG CAG representative to the ACDS in relation to clinical trial audits.

The ACDS continues to actively contribute to international efforts aimed at harmonising QA standards in clinical trials (Brooks et al. 2024).

The value of (a lot of) data

Since its inception more than 10 years ago, the ACDS has collected data from each audit. This dataset contains anonymised data for the majority of linear accelerators in Australia and many in New Zealand. As can be seen in the figure below, different audits feature different acceptance criteria and the CAG relies on this information to interpret audit outcomes and their significance. The figure shows more than 30,000 data points representing audit results of all levels.

In addition to helping to understand individual audit results, the compilation of the data provides reassurance that there is no significant systematic error in dosimetry in Australia and New Zealand and allows comparison with other national standard laboratories such as the Imaging and Radiation Oncology Core (IROC) in Houston, USA. The CAG noted with interest that in general, the tolerances in Australia are tighter which may reflect the technical quality of our radiotherapy services.

CAG regularly receives briefings on publications and conference presentations by ACDS, several of them informed by the dataset. Availability of these large datasets can inform the development of future audits, help spot small systematic differences between equipment, and may provide significant opportunities for future clinical research.

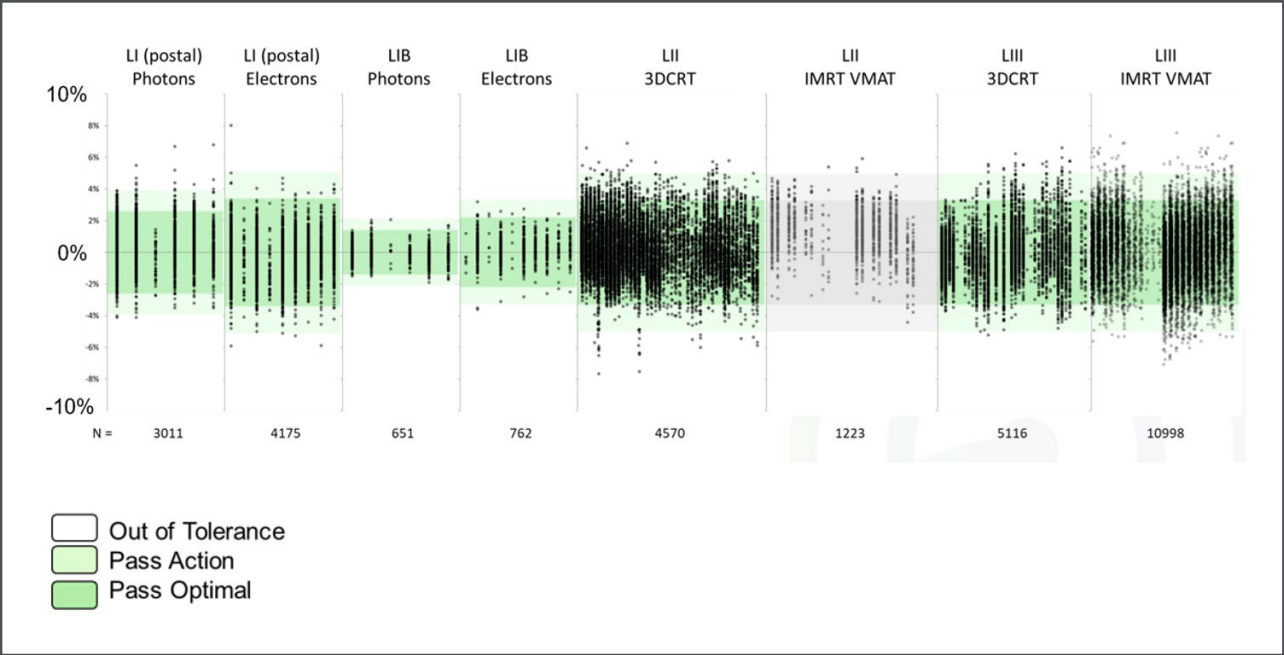


Figure: Illustration of the ANZ dosimetric dataset acquired in more than 1200 audits of different levels and complexity. As expected, the level I on-site audits are resulting in the tightest dosimetric outcomes. Data courtesy of B Healy, ACDS.

Resources required by facilities to participate in the audit program

The CAG reviews customer feedback sought by the ACDS from facilities to ensure ongoing quality improvement of the service. Survey responses from 17 medical physicists and 11 radiation therapists were reviewed during the 2023–24 financial year. Key findings are summarised below.

Radiation therapists feedback:

- 8 of 11 respondents agreed that audit involvement had improved their understanding of the role of clinical audits in ensuring patient safety, while 3 were neutral.
- Time needed for treatment planning: responses ranged from 3 to 50 hours.
- Time needed for treatment delivery: responses ranged from 1.5 to 8 hours.

Medical physicists feedback included:

- Time taken to complete physics planning tasks, including planning checks and patient specific QA, ranged from 1 to 30 hours.
- 14 of 17 respondents agreed that ACDS audits increased the facility's confidence in the accuracy of its QA practices.
- 12 of 17 respondents agreed that the ACDS had positively influenced practice change in their department.

Research and global knowledge sharing

The ACDS continues to work closely with, and is recognised as a peer among, leading global auditing programs. The ACDS continues to participate in numerous international intercomparisons, including:

- National Physical Laboratory (UK) - participated in ACDS Level I OSLD audit
- IAEA - ACDS Level I OSLDs used in blind dose test and dose linearity test
- IAEA - ACDS providing ongoing coordination of international inter comparison of radiochromic film dosimetry among IAEA Dosimetry Audit Network (DAN) members
- National Cancer Institute Malaysia - participated in ACDS Level I OSLD audit
- IROC, Houston USA - ACDS participated in IROC Level I audit using ARPANSA's linear accelerator.

Over the past decade, the ACDS has made substantial research contributions, enhancing the global understanding of dosimetry audits. The ACDS was invited to, and delivered, 10 national and international scientific and teaching presentations during the 2023–24 financial year. Further, the ACDS published 2 peer-reviewed publications regarding the audit program, including outcomes and the ongoing development of the audit suite (Smyth et al. 2024; Burton et al. 2024).

These presentations and publications continue to highlight the rigor, quality and transparency of the ACDS audit program.



Conclusion

ACDS dosimetry audits are essential for ensuring safe, high-quality radiation therapy for cancer patients undergoing radiation therapy. The ACDS, with the support of the CAG, remains committed to supporting the radiation oncology sector by providing an independent, internationally recognised audit service across Australia and New Zealand.

References

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2. Brooks F, Hussein M, Lye J, Diez P, Patel R, Nelson CL, Lehmann J, Clark CH, Kry SF (2024) ‘A validated framework: comparison of international dosimetry auditing procedures for clinical trials’, *Radiotherapy and Oncology*, 194:S4822-S4825.
3. Smyth L, Alves A, Collins K, Beveridge S (2024) ‘Gafchromic EBT3 film provides equivalent dosimetric performance to EBT-XD film for stereotactic radiosurgery dosimetry’, *Physical and Engineering Sciences in Medicine*, 47:1095-1106 <https://doi.org/10.1007/s13246-024-01430-z>.
4. Burton A, Gaudreault M, Hardcastle N, Lye J, Beveridge S, Kry S, Franich R (2024) ‘Optimized scoring of end-to-end dosimetry audits for passive motion management – A simulation study using the IROC thorax phantom’, *Physica Medica*, 121:103363 <https://doi.org/10.1016/j.ejmp.2024.103363>.

Glossary

Term	Abbreviation	Definition
Field trial audit		An audit at preclinical development stage
Flattening filter free	FFF	A photon beam from a linear accelerator generated without a flattening filter to provide a higher dose rate than a flattened beam
Level I audit		Reference dosimetry for photon and electron beams with passive detectors
Level Ib audit		Reference dosimetry for photon and electron beams with ionisation chambers
Level Ib kV audit		Reference dosimetry for therapeutic kilovoltage X-ray beams with ionisation chambers
Level II audit		Array dose measurements in a slab phantom to test treatment planning system performance
Level III audit		End to end testing with an anthropomorphic phantom and embedded dosimeters
Multi-leaf collimator	MLC	A series of radiation-shielding leaves for shaping the clinical photon beam to the intended target
Optically Stimulated Luminescence Detector	OSLD	Passive detectors used for Level I audits
Stereotactic ablative body radiotherapy	SABR	A radiotherapy technique to precisely deliver radiation dose in a small number of fractions to tumours in the body (except the brain)
Stereotactic radiosurgery	SRS	A radiotherapy technique to precisely deliver radiation dose in a single fraction, or a small number of fractions, to tumours in the brain
Treatment planning system	TPS	Computer system to generate radiotherapy treatment plans from 3D patient datasets.

Australian Clinical Dosimetry Service

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From our scientists to the world's first scientists, we respectfully acknowledge Traditional Owners and First Nations communities and their rich cultures. We recognise, respect and continue to learn from Indigenous sciences, and the deep understanding and observations of land, waters and sky carried and shared by First Nations peoples over thousands of years.

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