



Australian Clinical Dosimetry Service

Level III Audit – Fact Sheet

Definition

The ACDS Level III Audit determines absorbed dose to water delivered to selected points in an anthropomorphic phantom. This is an “end-to-end” audit where the phantom undergoes all steps in the treatment chain as normally experienced by a patient. The Level III audit includes a number of modalities, each with additional options. The facility can choose to complete as many options in the audit as deemed necessary for their clinical practice. Note the 3DCRT 6X modality must be completed.

3DCRT		3DCRT	IMRT	VMAT	SABR (Trial)
6X (Compulsory)	Optional Please select as relevant to clinical practice	10X	6X	6X	6X
		15X	10X	10X	10X
		18X	6FFF	6FFF	6FFF
		Wedges	10FFF	10FFF	10FFF
		6FFF			3DCRT, DCAT
		10FFF			IMRT, VMAT

Dosimetry measurements are made with an electrometer and ionisation chambers in a CIRS thorax phantom. Ion chambers are calibrated by the national primary standards laboratory at ARPANSA. As recommended by TRS-398, the ACDS uses ion chamber calibration factors determined in high-energy beams of similar quality (referred to as “Directly measured”).

Audit Coverage

The Level III Audit is available to all facilities as part of a scheduled 4 year program. The Level III Audit will be offered to facilities once during the 4 year program. Measurements are performed on a single representative Linac at each facility.

Audit Scope

The ACDS aims to ensure a high degree of independence from the Facility by providing external equipment and measurements whenever practicable. The ACDS will however assume that:

- The Linac has been accepted from the supplier by the Facility.
- The Linac has been commissioned by a certified ROMP (or equivalent) and performance (mechanical and radiation) is within Facility tolerance on the day of measurement.

The ACDS will typically perform independent measurements of:

- Ionisation chamber charge collected per Monitor Unit under conditions of Facility treatment plan.
- Phantom temperature & Ambient air pressure
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Audit Outcomes

Outcomes are attained for each modality the facility chooses to include in the audit. The local dose variation from each scored measurement point is assessed according to the following criteria.

Pass (Optimal Level)	Pass (Action Level)	Out of Tolerance	Reported not scored (RNS)
≤ 3.3%*	> 3.3% and ≤ 5%	> 5%	<ul style="list-style-type: none">○ deliveries restricted from clinical use○ repeated measurements○ out of field measurements○ supporting measurements.

*% dose variation = (Planned dose-ACDS measured dose) / ACDS measured dose

3DCRT

For 3DCRT cases the scoring criteria have been applied to 100% of the scored points (i.e. the audit outcome is derived from the point that returns the maximum absolute local dose variation).

IMRT and VMAT

The scoring criteria are applied to 94% of the points (i.e. the audit outcome is derived from the local dose variation returned after the worst point at each beam energy is excluded). If the absolute local dose variation of a point is outside ±8%, the point will not be excluded and an Out of Tolerance outcome will be returned.

Outcome Reporting

An individual report is created for each facility and is specific to the beam model(s) audited. A formal report will be sent to the Facility within approximately 14 days of the audit. Data collected is held confidentially by the ACDS and its oversight groups. Publicly reported outcomes are randomised and de-identified.

General Audit Procedures

- The standard procedure is for a two phase audit. In Phase 1, the Facility completes CT scanning and planning, followed by ACDS plan review off-site. In Phase 2, the ACDS is on-site for treatment delivery and dose measurements. These are normally performed with an extended interval in-between, with the phantom shipped to the Facility ahead of time.
- At minimum, the Facility should book staff and equipment for 8 hours of treatment planning time and 4 hours of treatment delivery time. Additional beam models will increase planning and delivery time required. If SABR is included, an additional ~3 hours of Linac time will be required.
- The Facility must ensure that (a) physics representative is available for the duration of the audit to provide supplemental information if required; (b) A radiation therapist representative/s are available for the duration of the audit to deliver the planned treatment and provide supplemental information if required.
- Measurements are required to be completed in clinical and R&V QA modes.
- For the IMRT, VMAT and SABR modalities, the facility must confirm the plans are deliverable and pass all QA measures for clinical IMRT/VMAT/SABR plans (Patient specific QA).
- For pre-treatment verification, CBCT is recommended, due to the lack of anatomical structures within the phantom. Planar imaging (kV or MV) is also acceptable.

Audit cases

For the 3DCRT modality there are 4 cases in the audit, with the option of repeating these cases with multiple beam models. The 3DCRT modality consists of reference and wedged beams, measured with and without lung inhomogeneity. A schematic of the cases is shown in Figure 1.

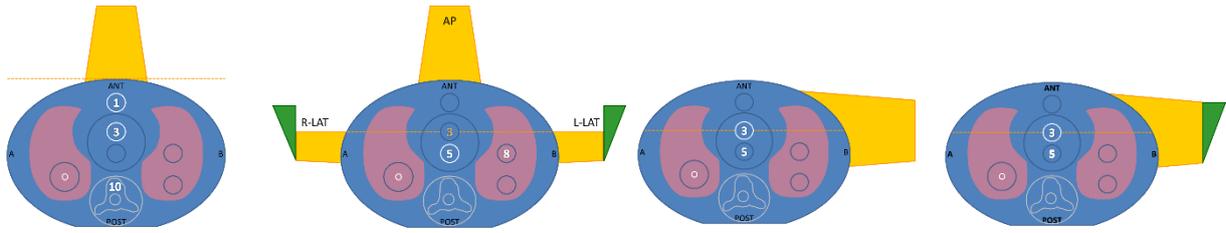


Figure 1. 3DCRT Cases 1-4

For the IMRT and VMAT modalities, there are 4 complex target volume cases. The facility has the option to include as many IMRT and/or VMAT beam models in the audit as applicable to their clinical practice.

- The chair test is an adaptation of the test described by Van Esch et al., where a chair-like fluence (Fig. 2) is delivered by dynamic MLC movement. The test aims to separate the effects of leaf transmission from dosimetric leaf separation in a single test.
- The C-Shape target volume has been adapted from AAPM: TG119, a horseshoe shaped target volume surrounding a central avoidance structure. Two treatment plans for the C-Shape are required; with and without inhomogeneities (Fig 3).
- The ACDS derived the 'complex' case from elements of IMRT/VMAT practice observed in the clinic. The complex case (Fig.4) consists of two adjacent target structures, with varying dose objectives, and an exclusion sphere fully encompassed by the higher dose target.

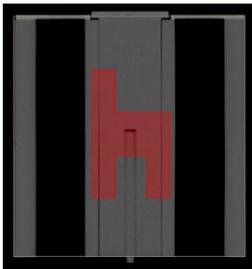


Figure 2. The 'Chair' test

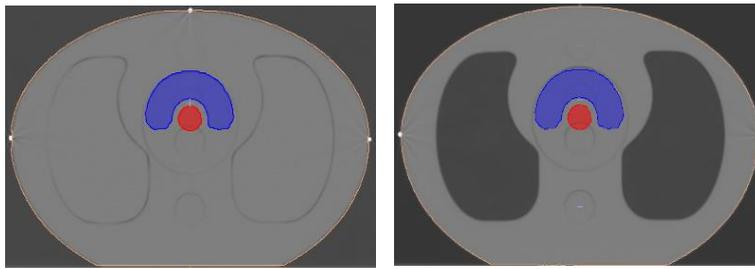


Figure 3. C-Shape with and without inhomogeneities

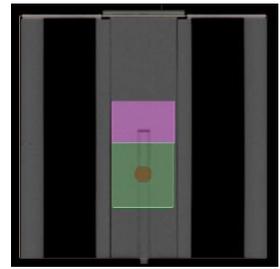


Figure 4. The Complex Case

For the SABR modality, three optional body sites are included in the audit: Soft Tissue, Spine and Lung. The facility has the option to include as many body sites, beam energies and delivery modalities are relevant to their clinical practice. Measurements are made with a PTW 60019 microDiamond and Gafchromic EBT3 film. The SABR modality is currently in trial, and thus the results are reported but not scored (RNS) against the overall audit outcome.

- The Soft Tissue case (Fig.5) is a surrogate for tumours treated with SABR in the Liver, Kidney and Prostate etc. This simple target volume is measured in a homogenous phantom, separating out the effects inhomogenities from TPS calculation.
- The Spine case (Fig.6) requires modulated deliveries for a complex target volume wrapping around the spinal cord.
- The Lung case (Fig.7) consists of a 2cm ‘tumour’ in lung inhomogeneity and follows the ITV approach.

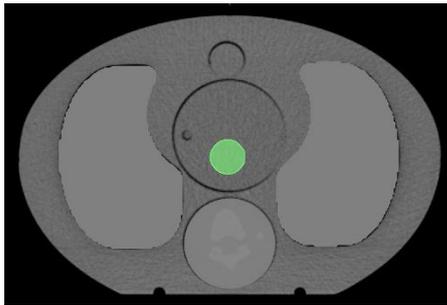


Figure 5. Soft Tissue Case

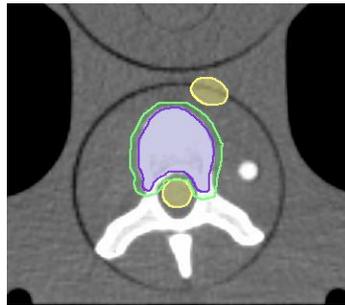


Figure 6. Spine Case

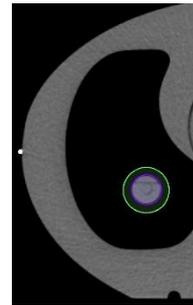


Figure 7. Lung Case