

Replacing CT Intravenous Urography with MR Urography in Children: A Closed-Loop Audit Achieving an 87% Reduction in Collective Radiation Dose

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BACKGROUND & OBJECTIVES

- Children are substantially more radiosensitive than adults, and CT exposure in childhood carries a measurable increase in lifetime cancer risk [4].
- CT intravenous urography (CT IVU) delivers among the highest paediatric doses in body imaging, whereas MR urography (MRU) provides comparable anatomical and functional information without ionising radiation [5].
- At our tertiary paediatric hospital, CT IVU remained the default urographic investigation; we therefore audited practice against radiation-protection standards.

STANDARDS, INDICATORS & TARGETS

STANDARD

In children requiring urographic imaging, a radiation-free alternative (MRU) should be used wherever clinically appropriate, in line with RCR iRefer guidance [1], ESPR/ESUR paediatric uroradiology recommendations [2] and ALARA (as low as reasonably achievable)/Image Gently principles [6].

INDICATOR

Proportion of paediatric urographic examinations performed as MRU.

TARGET

≥90%

of studies via MRU

METHODOLOGY

Retrospective closed-loop departmental audit of all urographic examinations in children aged 1–13 years over two equal 8-month cycles.

1ST AUDIT CYCLE • 1 January 2025 – 31 August 2025

INTERVENTION • 1 September 2025

2ND AUDIT CYCLE • 1 September 2025 – 30 April 2026

RESULTS — 1ST AUDIT ROUND

110

CT IVU (91.7%)

10

MRU (8.3%)

8.3%

compliance — target not met

A total of 120 urographic studies were performed.

RESULTS — 2ND AUDIT ROUND

97

MRU (87.4%)

14

CT IVU (12.6%)

87.4%

compliance — target not met

A total of 111 urographic studies were performed. Chi-squared test: $\chi^2 = 141.8$, $p < 0.001$ versus cycle 1.

QUALITATIVE OUTCOMES

- Radiologists reported satisfactory diagnostic confidence with MRU.
- Paediatric urologists confirmed MRU answered the clinical question in the vast majority of cases.
- Only a very small number of patients required subsequent CT IVU.

ACTION PLANS

1ST ACTION PLAN

A structured educational intervention with the paediatric urology team, delivered on 1 September 2025 at the start of cycle 2, addressed the radiation risks of CT IVU, ALARA principles and the diagnostic capabilities of MRU; an MRU-first urography pathway was agreed.

2ND ACTION PLAN

MRU-first vetting is being embedded at the point of request, referrer engagement continues, and a third cycle is planned to achieve and sustain the ≥90% target.

CT IVU DOSIMETRY

CT IVU cohort	Cycle 1 (n = 110)	Cycle 2 (n = 14)
Mean age (years)	7.7 ± 3.0 (range 1–13)	8.6 ± 3.0 (range 4–13)
Mean DLP (mGy·cm)	640.4 ± 55.7 (median 650, range 500–715)	660.7 ± 48.9 (median 672.5, range 585–725)
Mean effective dose (mSv)	11.1 ± 1.3 (median 10.5, range 9.7–15.6)	11.0 ± 1.0 (median 10.6, range 9.6–12.8)
Collective effective dose (mSv)	1224.8	153.9

CYCLE COMPARISON

Figure 1. Urographic examinations by modality and audit cycle.

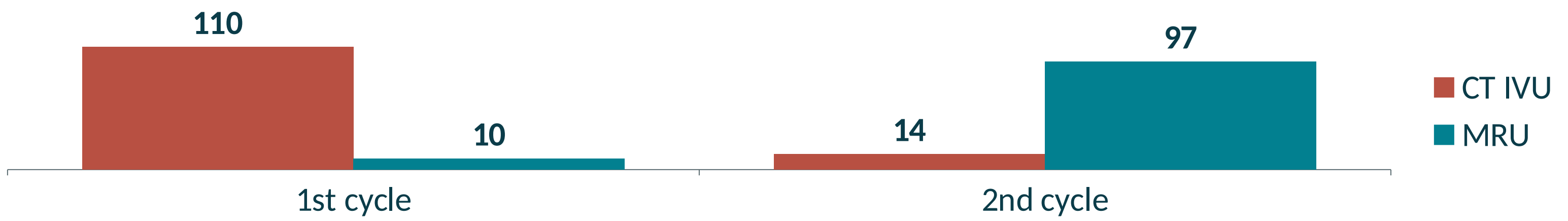
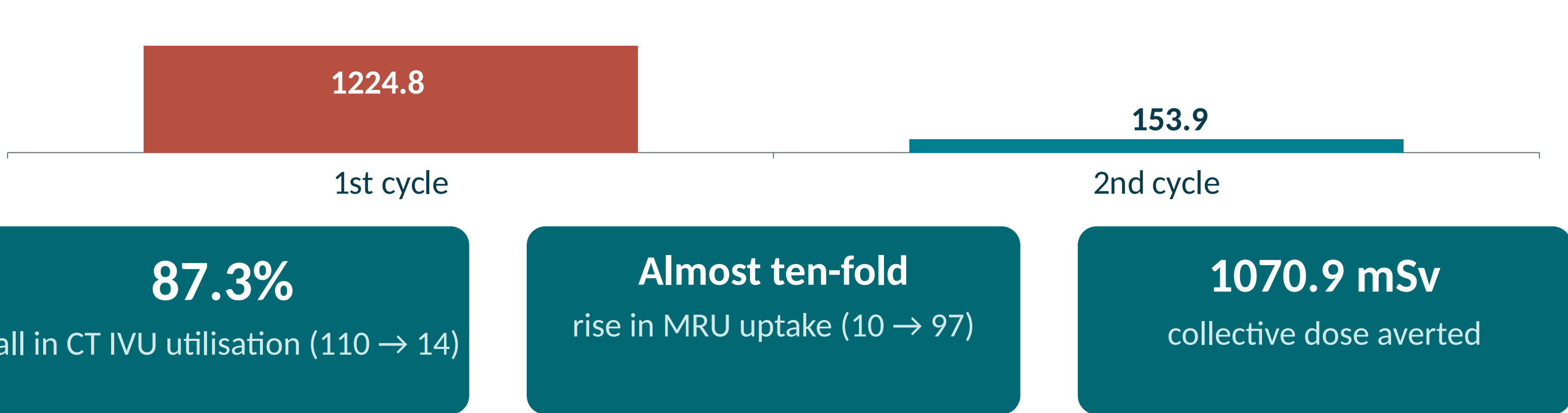


Figure 2. Collective effective dose per 8-month cycle (mSv).



CONCLUSIONS

A simple, low-cost educational intervention transformed paediatric urographic practice, raising MRU uptake from 8.3% to 87.4% and reducing collective radiation dose by 87.4% without compromising diagnostic confidence or patient care.

Dose estimation: for every CT IVU, dose-length product (DLP) was retrieved and effective dose estimated as $DLP \times \text{age-specific conversion coefficient for abdominopelvic CT}$ (0.030, 0.020 and 0.015 mSv·mGy⁻¹·cm⁻¹ for the 1-, 5- and 10-year reference phantoms respectively, nearest-phantom assignment; AAPM Report No. 96/Shrimpton et al. [3]).

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