Comparison of methodologies for calculating CT effective doses for unintended and accidental diagnostic procedures

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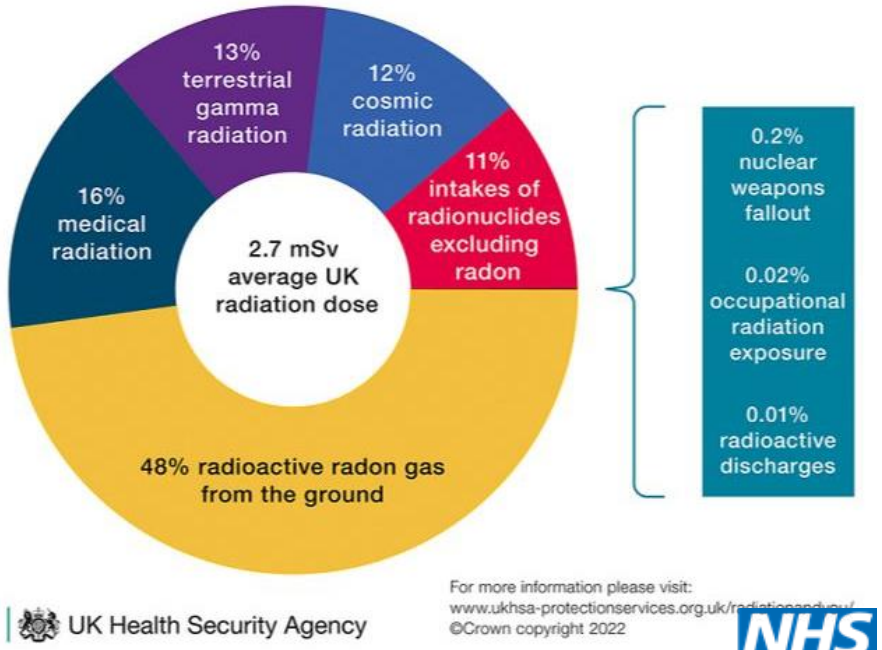
Introduction

- According to the UK Health Security Agency, medical radiation contributes to about 16% of the average UK radiation dose.
- Also, the CQC IR(ME)R report 2023/24 (1 April 2023 to 31 March 2024) [1] reveals that there were 470 Diagnostic Radiology incidents reported which accounts for 55% of reported incidents across all modalities. Of which 65% of this 55% originates from CT [1]



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IR(ME)R17

- IR(ME)R17, regulation 2 describes accidental exposure as an exposure of an individual as a result of an accident. It also describes unintended exposure as any exposure to ionising radiation significantly different from the exposure intended for a given purpose.
- This project aims to compare different methods for calculating estimated effective dose for reported CT radiation incidents.

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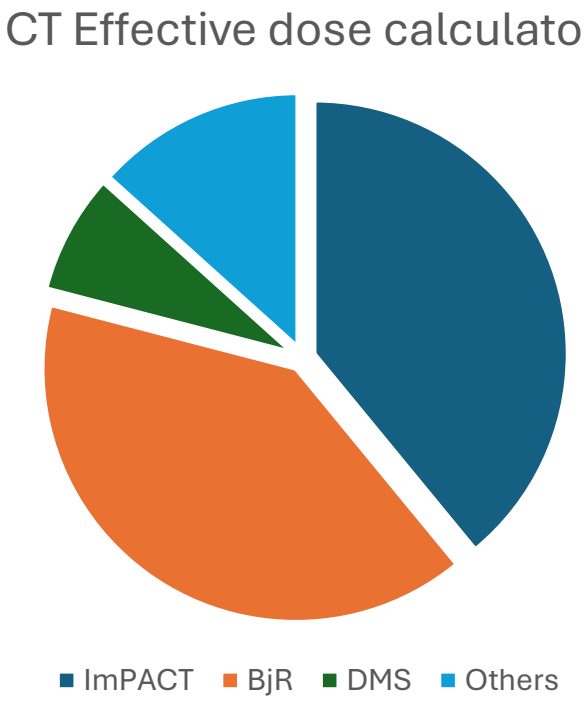
Effective dose

- Effective dose is the product of absorbed dose, tissue weighting factor and radiation weighting factor.
- The estimated effective dose for a CT examination is important in determining the radiation risk for unintended and accidental exposure. It is used to quantify the risk associated with exposure to radiation during a CT scan. It helps to understand the potential long-term risks from the radiation exposure.

A survey of over 45 hospitals in the UK highlighted almost 10 independent methods of calculating CT effective doses. Within each of these methods, there are also variations but for this presentation, I will be talking about the three most prominent ones.

Calculator	Number
ImPACT	41
BjR	42
DMS	8
Others	14



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Methodology

The effective doses of 13 accidental and unintended doses were calculated using the methods listed below

- ImPACT calculator (V1.0.4)
- ‘Updated estimates of typical effective doses for common CT examinations in the UK following the 2011 national review’ by Shrimpton et al. (Table 4/6)
- Waza-ari (web-based CT calculator)

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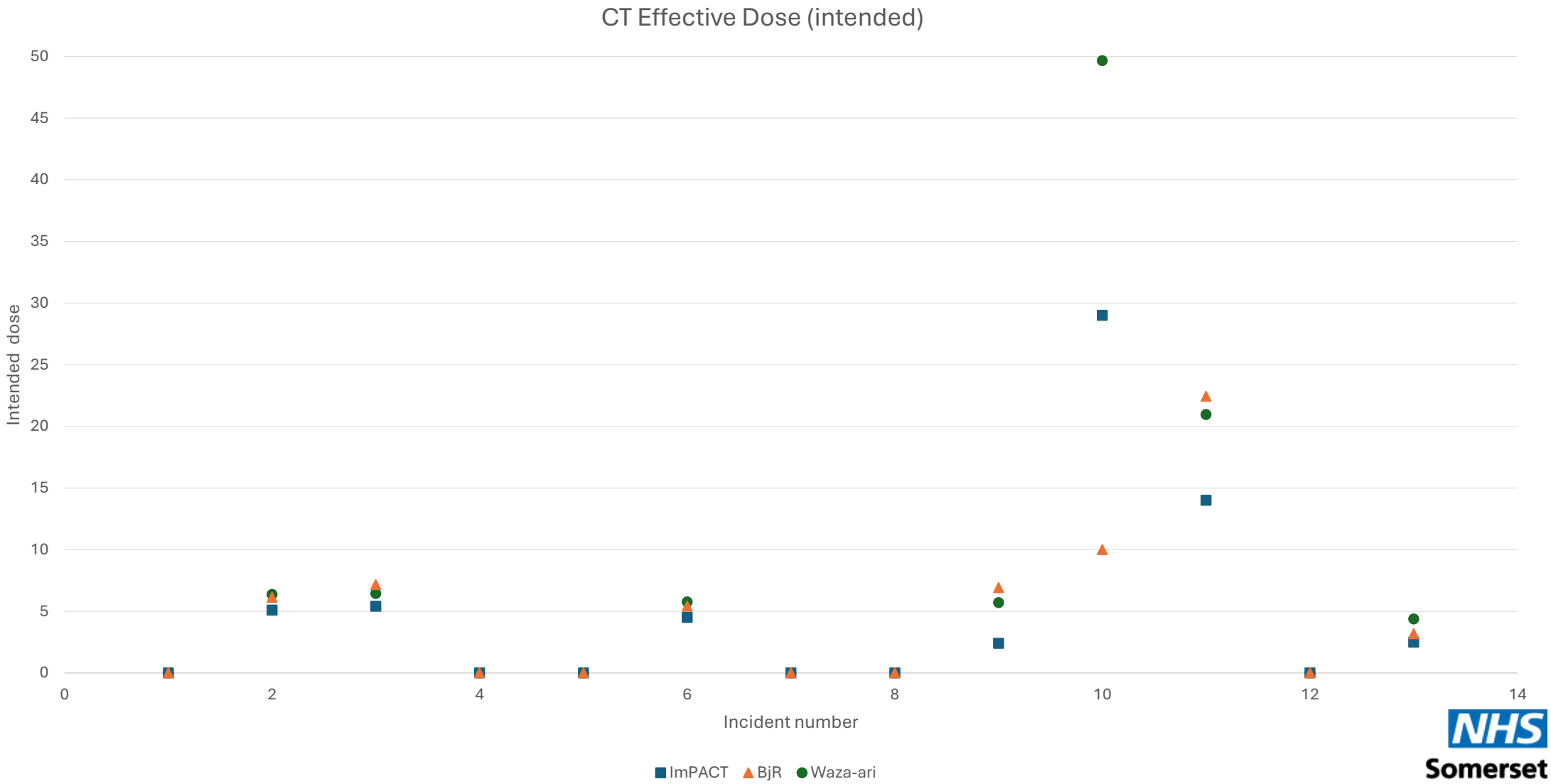
ImPACT vs BjR vs Waza-Ari

	Intended Dose (mSv)			Unintended/accidental Dose (mSv)			Total Dose (mSv)			SAUE Code		
	ImPACT	BjR	Waza	ImPACT	BjR	Waza	ImPACT	BjR	Waza	ImPACT	BjR	Waza
1	0	0.0	0.0	7.3	13.3	12.4	7.3	13.3	12.4	1	1	1
2	5.1	6.1	6.4	4.5	6.5	6.8	9.6	12.6	13.2	2.3	2.3	2.3
3	5.4	7.2	6.5	8.5	8.9	9.1	13.9	16.1	15.5	2.3	2.3	2.3
4	0	0.0	0.0	1.7	1.3	1.5	1.7	1.3	1.5	1	1	1
5	0	0.0	0.0	2.1	2.7	2.6	2.1	2.7	2.6	1	1	1
6	4.5	5.4	5.8	2.8	3.4	3.5	7.3	8.8	9.2	2.3	2.3	2.3
7	0	0.0	0.0	1.6	1.5	1.8	1.6	1.5	1.8	1	1	1
8	0	0.0	0.0	17	18.3	23.5	17	18.3	23.5	1	1	1
9	2.4	6.9	5.7	1.4	3.5	3.2	3.8	10.5	8.9	2.2	2.3	2.3
10	29	10.0	49.7	27	9.0	45.4	56	19.0	95.1	2.4	2.3	2.4
11	14	22.4	21.0	10	16.8	16.3	24	39.2	37.2	2.4	2.4	2.4
12	0	0.0	0.0	1.9	1.6	1.6	1.9	1.6	1.6	1	1	1
13	2.5	3.2	4.4	2.5	3.2	4.4	5	6.3	8.7	2.2	2.3	2.3



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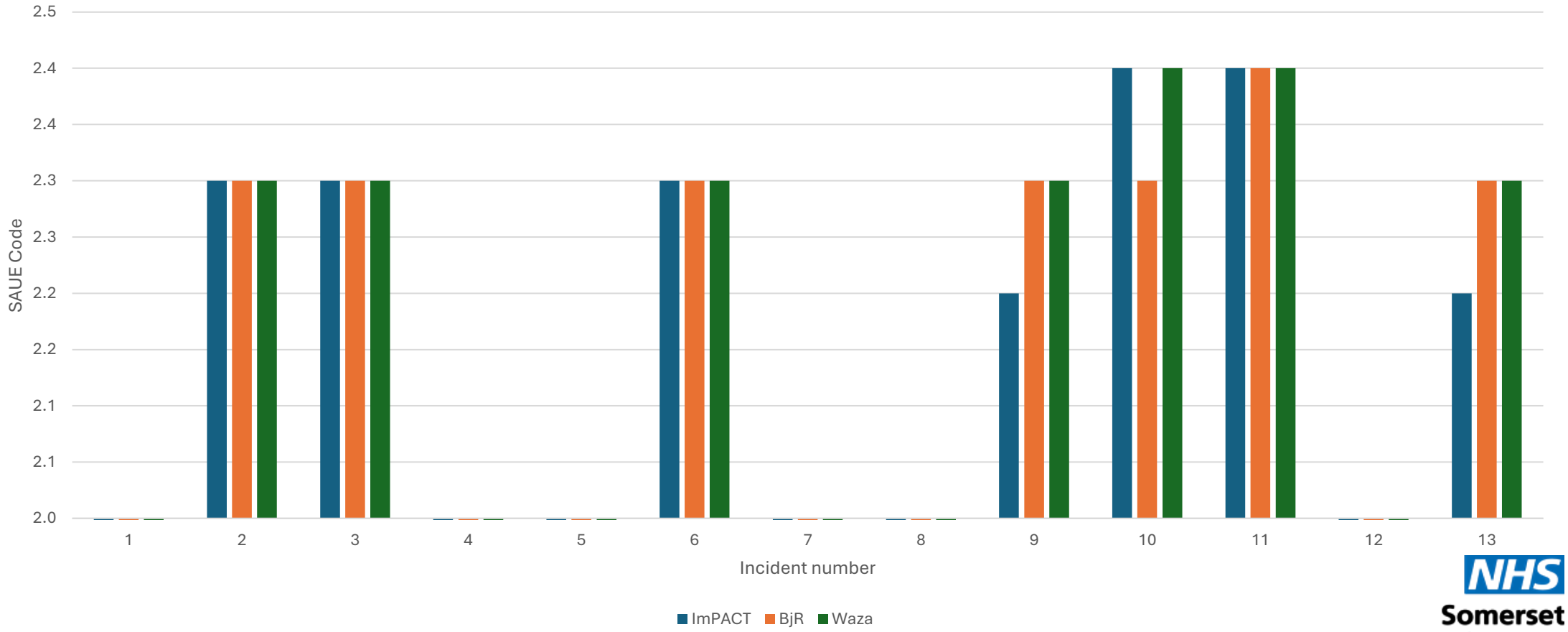
SAUE Code comparison



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From the data acquired, depending on the methodology used, there could be a difference of almost 500% in the estimated effective dose

The difference in methodology used also accounts for a difference of over 40% in the SAUE coding

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Discussion

These differences in methodologies bring about a level of inconsistency in the estimated effective dose being reported, while all of these methods are used as estimates and not as an absolute value, we are encouraged as scientists to produce reproducible results when possible as this allows for inter comparability and reduces error.

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It highlights the variation in the methods and the effect of these variations on the categorising of these incidents per the guidance published by CQC under the Significant Accidental and Unintended Exposure (SAUE) codes.

This project also highlights the discrepancies in the individual methodologies used. For example, the various versions/modifications of the ImPACT calculator and the different tables used to select the conversion factor for the effective dose when using the paper published by Shrimpton et al. titled ‘Updated estimates of typical effective doses for common CT examinations in the UK following the 2011 national review’.

Conclusion

Although, the estimated effective dose is not an absolute value, the margin for variation can be reduced by having a standardised method for this calculation across the different Trusts.

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Thank you

Any question?

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