

Challenges in estimating Patient Dose – 3 Case Studies

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Purpose

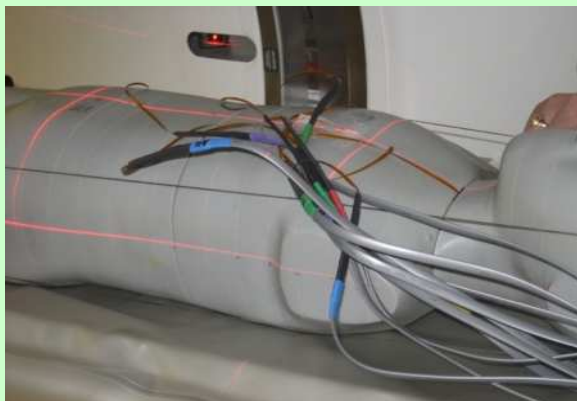
- Effective Dose estimates are frequently requested and useful for
 - Protocol Review & Modification
 - Dose reduction
 - Technique/Modality comparison
 - Cumulative patient exposure
 - Research papers
 - Patient queries

Materials & Methods for Effective Dose Estimation

Published Conversion Coefficients in CT

Region of body	Normalised effective dose, E_{DLP} (mSv mGy ⁻¹ cm ⁻¹)
Head	0.0023
Neck	0.0054
Chest	0.017
Abdomen	0.015
Pelvis	0.019

ATOM phantom with Mosfets in place



Impact Dosimetry Calculator – current version

IMPACT CT Patient Dosimetry Calculator
Version 1.0 28/08/2009

Scanner Model:		Acquisition Parameters:	
Manufacturer:	GE	Tube current	37 mA
Scanner:	GE LightSpeed VCT	Rotation time	0.5 s
KV:	100	Spiral pitch	0.984
Scan Region:	Body	mAs / Rotation	18.5 mAs
Data Set	MCSET05	Effective mAs	18.80081 mAs
Current Data	MCSET05	Collimation	40 mm
Scan range		Rel. CTDI	0.858106
Start Position	1 cm	CTDI (air)	20.796 mGy/100mAs
End Position	47 cm	CTDI (soft tissue)	22.3 mGy/100mAs
Organ weighting scheme	ICRP 103	CTDI _w	6.1654 mGy/100mAs
		CTDI _{vol}	1.2 mGy
		DLP	53 mGy.cm

Organ	w _r	H _T (mGy)	w _T H _T	Remainder Organs	H _T (mGy)
Gonads	0.08	0.7	0.056	Adrenals	1.2
Bone Marrow	0.12	0.61	0.073	Small Intestine	1.3
Colon	0.12	1.3	0.15	Kidney	1.7
Lung	0.12	0.46	0.055	Pancreas	1.1
Stomach	0.12	1.5	0.18	Spleen	1.4
Bladder	0.04	1.4	0.057	Thymus	0.064
Breast	0.12	0.083	0.0099	Uterus / Prostate (Bladder)	1.3
Liver	0.04	1.4	0.057	Muscle	0.7
Oesophagus (Thymus)	0.04	0.064	0.0026	Gall Bladder	1.3
Thyroid	0.04	0.0045	0.00018	Heart	0.3
Skin	0.01	0.67	0.0067	ET region (Thyroid)	0.0045
Bone Surface	0.01	0.94	0.0094	Lymph nodes (Muscle)	0.7
Brain	0.01	0.00033	3.3E-06	Oral mucosa (Brain)	0.00033
Salivary Glands (Brain)	0.01	0.00033	3.3E-06	Other organs of interest	H _T (mGy)
Remainder	0.12	0.88	0.11	Eye lenses	0.001
Not Applicable	0	0	0	Testes	0.2
				Ovaries	1.2
				Uterus	1.2
				Prostate	1.4
Total Effective Dose (mSv)					
					0.76

Scan Description / Comments: CTDI vol: 1.18 mGy DLP: 52.47mGy.cm
Estimated Effective Dose = 0.76mSv

Option of 103 or 60

CTDI & DLP (calculated) based on exposure parameters & scan length

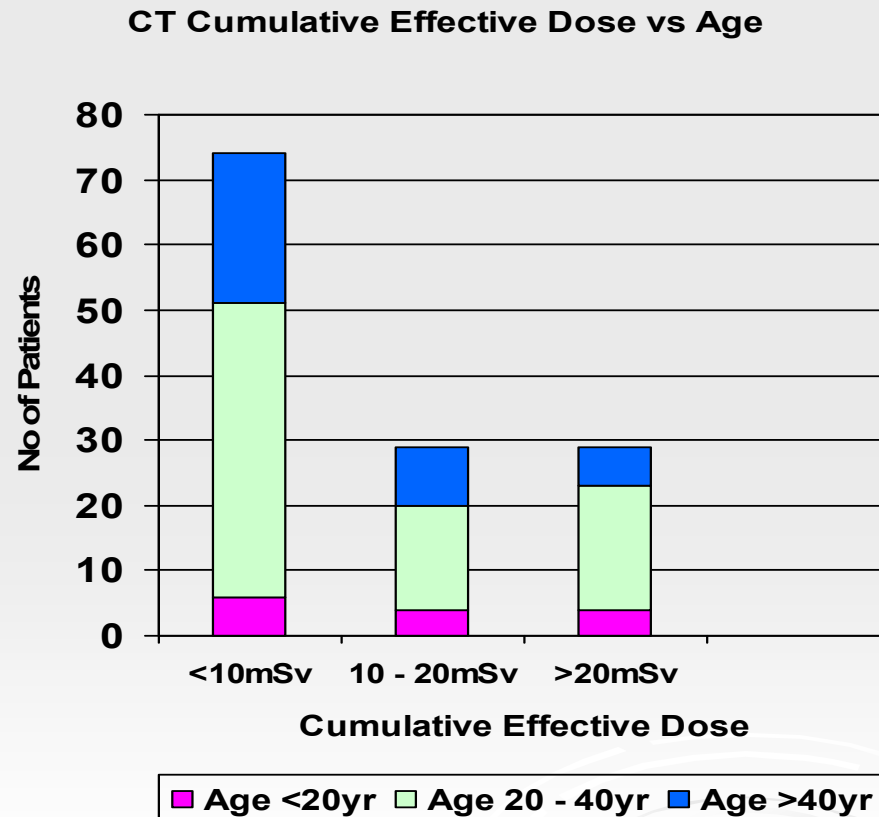
Effective dose (mSv)

CTDI & DLP displayed on scanner

PCXMC Software

Results

- Study 1: Radiation dose associated with CT with examinations in patients with Crohn's disease



- Retrospective study of 400 patients (235 had CT exams)
- Method: **CT conversion coefficients**
- Effective dose range: 0.3 – 68.7mSv
- Mean 12.4mSv

- *Paper published in Gut 2008; 57:1524 -1529. Crohn's disease: factors associated with exposure to high levels of diagnostic radiation*

Results

- Study 2: Development of ultra-low dose HRCT protocol for paediatric cystic fibrosis patients
 - 25 Paediatric patients with Cystic Fibrosis
 - Ethical approval obtained
 - Protocol: 120kV/30-50mA/0.5sec/2mm/6 slices
 - Method: **Impact Dosimetry calculator**
 - Effective dose <0.2mSv
 - *Paper has been accepted for publication in Radiology*

Results

➤ Study 3: Renal Study (*Work in progress*)

- Haemodialysis patients undergoing interventional procedures
- Effective dose estimates from: Ashsplit, Hickman, Portacath, Fistulogram, Fistuloplasty
- Method: **PCXMC** (central irradiation) and/or **DAP conversion coefficients** (upper limbs)

Resulting Effective Dose (mSv)

Exam	Min (mSv)	Max (mSv)	Mean (mSv)
Ashsplit	0.02	7.93	0.52
Hickman	0.03	4.77	0.65
Portacath	.02	4.21	0.34
Fistulogram	0.02	7.15	1.49
Fistuloplasty	.03	1.26	0.71

Conclusion

- Cautionary Note on Effective dose estimation
 - **Conversion Factors** are non specific for body habitus
 - Using **Impact Dosimetry Tool**
 - Designed for single mA for entire scan
 - Unable to deal with Scan Projection Radiographs
 - Difficulty with unequally distributed axial scans
 - Assumptions required with very thin slices
 - Non specific for body habitus
 - Using **PCXMC**
 - DAP meters must be calibrated
 - Inclusion of upper and lower limb dose contribution uncertain
 - Validation of CTDI and DLP is an issue with tube current modulation

Thank you for your interest

- If you have any questions or comments during the conference, please email me at the following address annemarie.mcgarrrigle@tyndall.ie or after the conference at annemarie.mcgarrrigle@hse.ie for further discussion