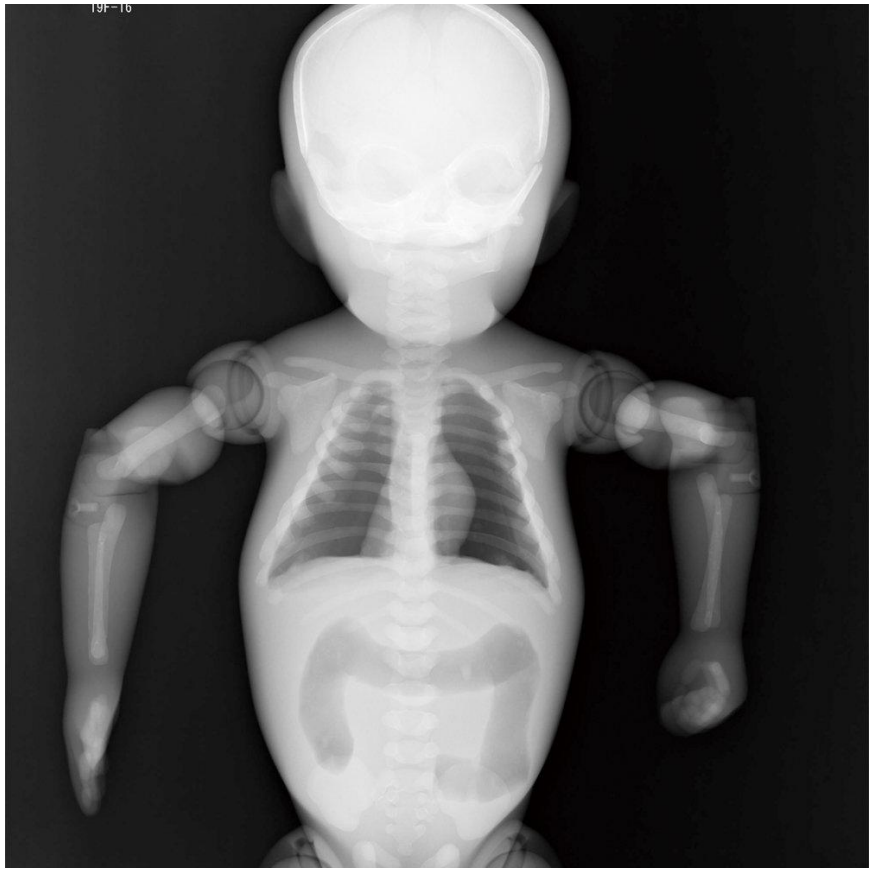
Dose Implications for Incorrect Protocol Selection for Paediatric Head CT

Heloise Carpenter



[1] Kyoto Kagaku Newborn Whole Body Phantom "PBU-80"Newborn Whole Body Phantom "PBU-80" | KYOTO KAGAKU

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NHS
Barking, Havering and Redbridge University Hospitals NHS Trust

Data Included in this Study

- All paediatric patients under 1 year old between 01/01/2025-31/03/2026 (65 patients)
    - 52/65 QH
    - 13/65 KGH

Current Status

- 52% of under 1 head CTs at BHRUT are completed on a paediatric protocol
- All patients at KGH received the correct protocol (as the protocol is chosen based on the patient DOB) New audit KGH GE does not do this
- At QH radiographers are manually adjusting the adult protocols rather than using the paediatric protocol (no standardisation leading to variation in doses)
- Median DLP is 293 mGycm (national DRL is 290)
- The highest DLP received was for an 11 month old who received an adult protocol. The DLP was 1016.43 (3.5 x higher than the NDRL) and the tube current was regularly over 300 for this

Canon Aquilion One

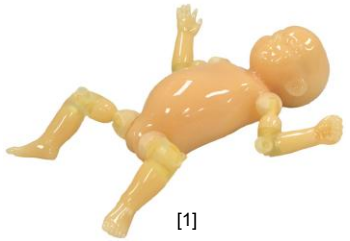


[2]

Protocol	kV	mA	Absorbed Dose (mGy)	Dose implication
Brain Baby 0-1yrs	100	280	17.67	N/A
Brain Baby 0-1yrs	80	280	8.74	Approx 50% reduction
Brain Baby 0-1yrs	120	280	29.1	Approx 65% increase
Brain Baby 0-1yrs	135	280	38.82	Over x2 dose
Brain Helical	120	TCM 140	27.77	Approx 50% increase
Brain Helical	100	TCM 220	25.34	Approx 50% increase
Brain Helical	80	TCM 330	18.05	Approx 2% increase

[2] **TO CTDI plus, Leeds Test Objects,** TO CTDI plus - Leeds Test Objects

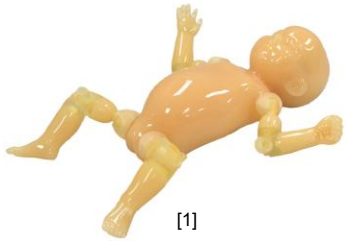
GE Revolution Ascend



[1]

Protocol	kV	mA	Absorbed Dose (mGy)	Dose implication
Baby Head 0-1 yrs	100	140	8.793	N/A
Baby Head 0-1 yrs	100	TCM 50-250	14	45% increase
Adult Head	120	TCM 250-350	49.3	140% increase
Adult Head	80	TCM 250-350	16.25	60% increase
Adult Head	100	TCM 250-350	31.7	113% increase
Adult Head	140	TCM 250-350	69.69	155% increase

Siemens Xcite



[1]

Protocol	kV	mA	Absorbed Dose (mGy)
Baby Brain	100	TCM 158-200	23.1
Child Brain	100	TCM 140-201	23.3
Adult Brain	120	266 mA	49.7

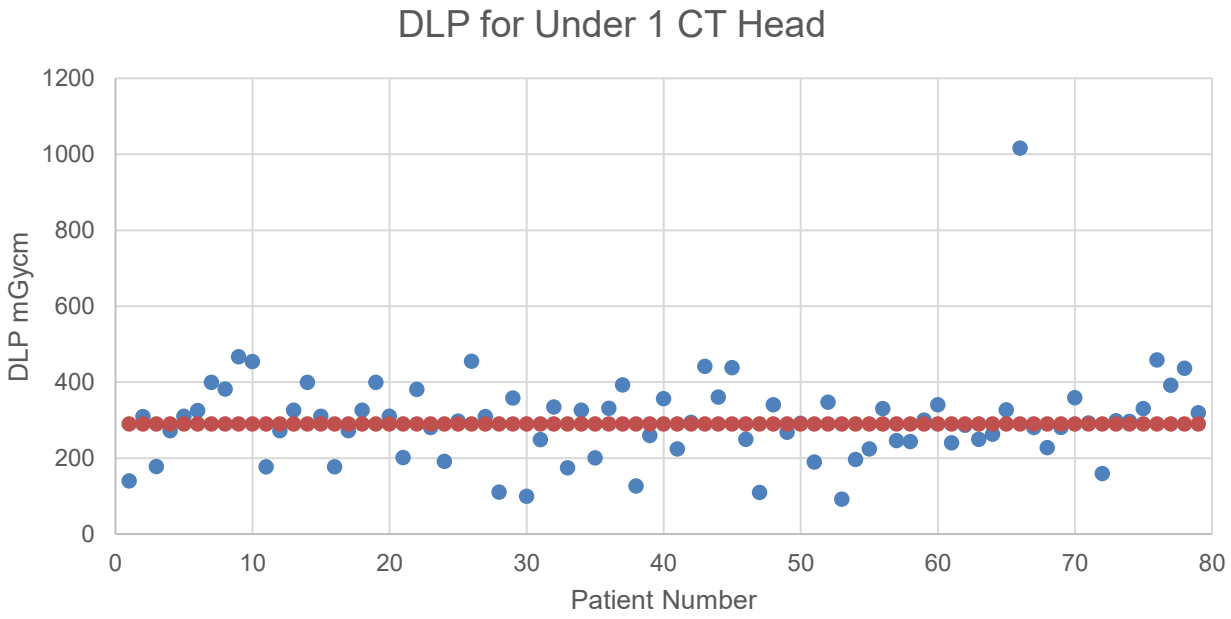
Example Data (Using ImPACT)

Scanner	# Adult Protocols	Median Effective Dose (mSv)	# Baby Protocols	Median Effective Dose (mSv)
Old Siemens QH	6	2.106	2	1.651

Further Data

From November 2025- June 2026: 1 out of 14 patients was scanned on the correct protocol

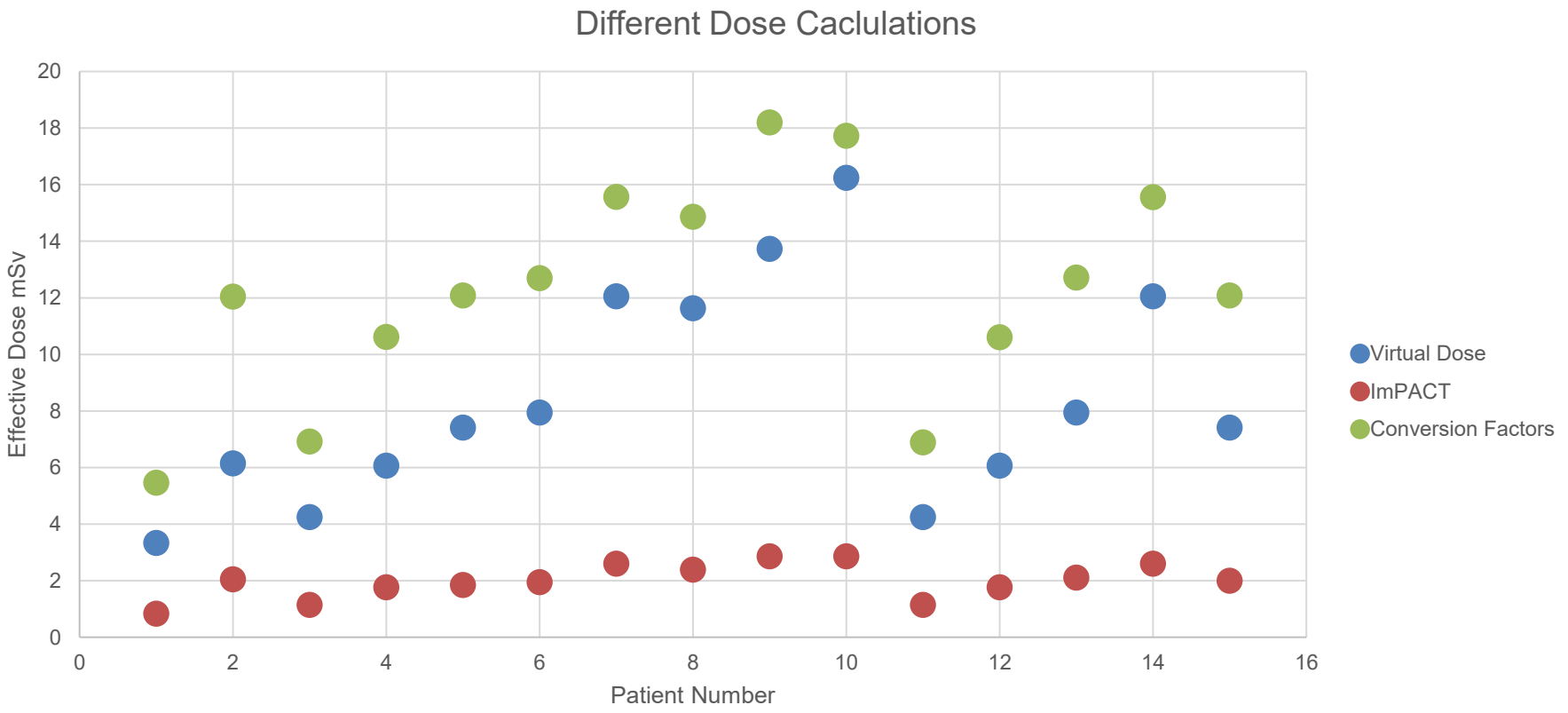
Data for January 2025-June 2026 can be seen below (median DLP 297 mGycm)



Virtual Dose Calculator

- Phantoms: 25 whole body Boundary Representation (BREP) phantoms
- Dose measurements measured on a Siemens SOMATOM Sensation 16 and GE LightSpeed Pro 16 and other scanners are normalised to a CTDIvol of a tube current of 100mAs
- Compare Monte Carlo MCNPX code to normalised dose
- Convert the CTDI100 in air at isocentre per 100 mAs for one slice to scanner model, divide by the air kerma values per gram per source parcel from the MCNPX simulation
- Virtual dose sums the dose per axial slice along the scan range (where non integer slice numbers use linear interpolation algorithms), and in helical scan modes incorporates the pitch.
- To account for Tube Current Modulation the average tube current per rotation is used
- 60,000 Monte Carlo Simulations database
- VirtualDose: A Software for Reporting Organ Doses from CT for Adult and Pediatric Patients - PMC

Comparing Dose Calculation Software



Conversion Factors: Chu, P.W., Kofler, C., Mahendra, M. *et al.* Dose length product to effective dose coefficients in children. *Pediatr Radiol* **53**, 1659–1668 (2023). https://doi.org/10.1007/s00247-023-05638-1

Optimisation Trial

GE Ascend had fixed tube of 140 mA Canon Aquilion One Scanner, had fixed tube current of 280mA.

Two Consultant Radiologists ranked images of the Kyoto Kagaku Newborn Whole Body Phantom (260 mA – 140 mA in 20 mA increments and with TCM) using the following criteria

Noise									
1 Non Diagnostic	2 Very Poor	3 Poor	4 Below Average	5 Acceptable	6 Fair	7 Good	8 Very Good	9 Excellent	10 Ideal

All Images were ranked as “Good” by one radiologist

All images were ranked as “Very Good” by the second radiologist

Resulted in a 56% dose decrease reducing the dose from 280 mA to 160 mA (only one patient scanned so far)