Effective radiation doses and associated risks

General X-ray

The Royal Children's Hospital Melbourne

Medical Imaging

This poster describes typical effective doses from common paediatric studies performed at the RCH, the associated lifetime risk of cancer incidence and level of risk. The effective doses are also expressed in terms of 'background equivalent radiation time' (BERT) and the number of hours of international flight time. The terminology used, including BERT and international flight time, will assist you in conveying the associated lifetime risk of cancer incidence and level of risk to health professionals, patients and carers in ways that are easy to understand.

All medical procedures involving ionising radiation exposure must be justified and approved.

All examinations should be conducted so that the dose to the patient is the lowest necessary to achieve the clinical aim.

General X-ray

The effective dose estimates for weight ranges are based on the RCH general X-ray exposure chart. Estimates quoted are the maximum values. For example, the effective dose for an abdomen AP exam for a child weighing 26–60 kg is less than 0.18 mSv and the risk of cancer incidence is better than one in 26,900 which is considered to be a very low level of risk. The effective dose from this abdomen AP exam is the same as from the natural background radiation that the patient would receive in less than 1.5 months or about 75 hours of international flight time.

When multiple exams and/or views are performed you can estimate the cumulative risk by summing the dose and BERT estimates together. For example, a chest AP and lateral for a child weighing 26–60+ kg would have an effective dose of less than 0.08 mSv which is less than 20 days of BERT or about 34 hours of international flight time.

The natural (non-radiation induced) childhood cancer incidence rate in Australia is about one in 5,800 per year, or one in 600 before the age of 15 years.

For reference, the Calman risk classification and terminology model is used.

Term	Risk range
High	<1:100
Moderate	1:100 to <1:1,000
Low	1:1,000 to <1:10,000
Very low	1:10,000 to <1:100,000
Minimal	1:100,000 to <1:1,000,000
Negligible	≥1:1,000,000

View/weight range	Typical effective dose (mSv)	Risk of cancer induction	Level of risk	BERT (1.5 mSv pa)	International flight time (hours)
Chest AP (note that a PA view would be significantly less dose and risk)					
3–25 kg	0.01	<1 in 216,000	Minimal	~2.4 days	4
26–60+ kg	0.03	<1 in 166,000	Minimal	~7.3 days	13
Chest lateral					
3–25 kg	0.02	<1 in 178,000	Minimal	~4.9 days	8
26–60+ kg	0.05	<1 in 105,000	Minimal	~12.2 days	21
Abdomen AP					
3–25 kg	0.03	<1 in 99,700	Very low to minimal	~7.3 days	13
26–60kg	0.2	<1 in 26,900	Very low	~1.5 months	75
60+ kg	0.3	<1 in 19,300	Very low	~2.3 months	121
Shoulder (3–60+ kg)					
AP	<0.03	<1 in 201,000	Minimal	<7.3 days	<13
Lateral	<0.01	<1 in 655,000	Minimal	<2.4 days	<4
Pelvis AP					
3–25 kg	0.02	<1 in 182,000	Minimal	~4.9 days	8
26–60 kg	0.07	<1 in 66,500	Very low	~17 days	29
60+ kg	0.1	<1 in 44,700	Very low	~29 days	50
Lower extremities (3–60+ kg)					
Knee AP & lateral (2 views)	<0.001	<1 in 10,470,000	Negligible	~1 hour	<1
Tib/fib AP & lateral (2 views)	<0.001	<1 in 5,233,000	Negligible	~3.5 hours	<1
Ankle AP, mortise & lateral (3 views)	<0.001	<1 in 11,120,000	Negligible	~1hour	<1
Foot AP, oblique & lateral (3 views)	<0.001	<1 in 11,240,000	Negligible	<1 hour	<1
C-spine AP & lateral (2 views)					
3–15 kg	0.02	<1 in 148,000	Minimal	~4.9 days	8
C-spine AP, odontoid & lateral (3 views)					
16–60 kg	0.03	<1 in 127,000	Minimal	~7.3 days	13
60+ kg	0.06	<1 in 93,500	Very low to minimal	~12 days	25
C-spine AP, odontoid, lateral & swimmers (4 views)					
26–60 kg	0.06	1 in 78,900	Very low to minimal	~12 days	25
60+ kg	0.1	1 in 60,600	Very low	~24 days	42
T-spine AP & lateral (2 views)					
3–15 kg	0.04	1 in 54,200	Very low to minimal	~10 days	17
16–40 kg	0.1	1 in 35,100	Very low	~24 days	42
41–60+ kg	0.2	1 in 27,300	Very low	~1.6 months	84
T-spine AP & breathing lateral (2 views)					
26–40 kg	0.3	1 in 11,200	Very low	~2.6 months	134
41–60 kg	0.5	1 in 9,400	Low to very low	~3.6 months	188
60+ kg	0.6	1 in 9,300	Low to very low	~4.8 months	251
L-spine AP & lateral (2 views)					
3–15 kg	0.06	1 in 38,300	Very low	~12 days	25
16–40 kg	0.1	1 in 27,200	Very low	~1 month	54
41–60 kg	0.2	1 in 22,100	Very low	~1.5 months	79
60+ kg	0.3	1 in 16,900	Very low	~2.6 months	138
Skull (3-60+ kg)					
AP & lateral (2 views)	0.03	<1 in 83,700	Very low to minimal	~7.3 days	13
AP, lateral, SMV & Townes (4 views)	0.07	<1 in 38,800	Very low	~17 days	29
Skeletal survey NAI					
3–7 kg	0.3	<1 in 8,400	Low to very low	~2 months	105
8–15 kg	0.3	<1 in 8,200	Low to very low	~2.2 months	117
16–25 kg	0.5	<1 in 5,600	Low to very low	~3.9 months	205
26–40 kg	0.7	<1 in 4,900	Low to very low	~5.9 months	309
41–60 kg	0.9	<1 in 4,600	Low	~7.2 months	376
60+ kg	1.3	<1 in 6,500	Low	~11 months	565
Skeletal survey bone dysplasia					
3–7 kg	0.2	<1 in 11,600	Very low	~1.4 months	75
8–15 kg	0.2	<1 in 11,100	Very low	~1.8 months	92
16–25 kg	0.3	<1 in 8,000	Low to very low	~2.7 months	142
26–40 kg	0.5	<1 in 7,400	Low to very low	~3.9 months	205
41–60 kg	0.6	<1 in 6,700	Low to very low	~5.1 months	268
60+ kg	1.0	<1 in 9,000	Low	~7.8 months	406

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