Web appendix: Supplementary materials

Table S1. Mean and standard deviation for effective radiation doses and percentage of high dose examinations for computed tomography (CT) by patient age, sex, size, institutional characteristics, machine and facility volume, manufacturer and country, unadjusted for patient factors.

		Abdomen		**Chest**		**Combined chest and abdomen**		**Head**		**Suspected Pulmonary Embolism**	
		Effective dose, mSv		**Effective dose, mSv**		**Effective dose, mSv**		**Effective dose, mSv**		**Effective dose, mSv**	
		Mean Effective Dose (SD)	% High Dose	Mean Effective Dose (SD)	% High Dose	Mean Effective Dose (SD)	% High Dose	Mean Effective Dose (SD)	% High Dose	Mean Effective Dose (SD)	% High Dose
Patient age, years	15–30	10·4 (8·1)	14	6·5 (6·7)	24	18·5 (12·7)	30	1·7 (1)	24	5·9 (4·8)	17
	30–40	12·5 (9·4)	21	6·8 (6·7)	28	18·1 (12·3)	26	1·8 (1)	24	7 (5·6)	24
	40–50	13·7 (10·3)	25	6·5 (6·5)	26	17·8 (11·8)	25	1·8 (1)	24	7·5 (6·1)	27
	50–60	14·3 (10·8)	27	6·2 (6·5)	24	17·5 (11·8)	23	1·8 (1)	25	7·7 (6·5)	29
	60–70	14·7 (11·2)	28	6·0 (6·3)	23	16·7 (11·1)	22	1·8 (0·9)	25	7·5 (6·3)	27
	70–80	13·7 (10·4)	25	6·1 (6·1)	23	15·5 (10·1)	18	1·8 (0·8)	25	7·1 (6·1)	25
	80–99	11·3 (8·7)	16	6·0 (6·0)	20	13·9 (9·2)	13	1·9 (0·8)	26	6·1 (5·3)	18
Sex	Female	12·3 (9·3)	21	5·6 (5·8)	20	14·9 (10·2)	16	1·7 (0·8)	21	6·5 (5·4)	21
	Male	14·5 (11·2)	28	6·8 (6·8)	28	18·2 (11·8)	26	1·9 (1)	29	8·1 (6·7)	30
Patient diameter	Smallest	8·0 (6·4)	7	4·6 (5·7)	15	10·7 (7·9)	7	1·5 (1·1)	18	4·2 (3·5)	7
	Small	9·8 (7·1)	11	4·7 (4·7)	13	12·7 (7·7)	8	1·8 (0·8)	21	5·1 (3·7)	11
	Medium	12·2 (8·2)	18	5·7 (5·4)	18	15·6 (8·7)	16	1·9 (0·7)	25	6·3 (4·3)	19
	Large	15·6 (10·0)	29	7·0 (6·1)	27	19·7 (10·4)	29	2·0 (0·8)	30	7·9 (5·3)	30
	Largest	21·4 (12·8)	55	9·7 (8·2)	50	26·3 (13·4)	52	2·2 (1)	40	11 (7·2)	52
When scanned	Night	11·7 (8·3)	18	7·5 (6·6)	31	18·4 (11·8)	26	2·0 (0·9)	30	7 (5·5)	24
	Day	13·5 (10·5)	25	6·1 (6·3)	23	16·5 (11·1)	21	1·8 (0·9)	24	7·2 (6·1)	25
Institutional Characteristics	Trauma center Yes	13·1 (10·1)	22	7·4 (7·3)	30	18·1 (12·3)	25	2·0 (0·9)	31	7·2 (6·6)	24
	Trauma center No	13·5 (10·4)	25	5·5 (5·6)	20	16·0 (10·6)	20	1·7 (0·9)	20	7·1 (5·5)	25
	Scans 24/7 Yes	15·8 (11·9)	33	5·5 (5·4)	20	18·0 (11·1)	25	1·5 (1·1)	16	6·9 (5·9)	24
	Scans 24/7 No	12·7 (9·8)	22	6·5 (6·6)	25	15·6 (11·1)	18	1·9 (0·9)	26	9·5 (7·3)	41
	Academic Yes	12·9 (9·6)	22	6·3 (6·6)	24	16·8 (10·8)	22	1·9 (0·9)	25	7·1 (6·5)	25
	Academic No	13·7 (10·8)	25	6·0 (6·1)	24	16·1 (11·7)	19	1·8 (0·9)	25	7·2 (5·5)	25
	Private Yes	17·5 (12·8)	36	5·0 (5·1)	19	22·4 (12·5)	37	1·9 (1)	19	8·0 (4·5)	31
	Private No	12·9 (9·8)	22	6·3 (6·4)	24	16·4 (11·1)	21	1·8 (0·9)	26	7·1 (6·1)	25

Machine Volume	1 - 6	13·1 (10·2)	23	5·5 (5·8)	19	15·5 (9·6)	14	1·4 (1·1)	16	7·8 (6·6)	30
	6 - 9	13·1 (10·1)	22	5·7 (5·7)	23	15·1 (12·4)	15	1·9 (0·9)	24	7·9 (6·2)	36
	9 - 12	13·0 (9·8)	23	6·4 (6·3)	25	16·1 (9·7)	19	1·7 (0·8)	17	6·7 (5·3)	23
	12 - 20	14·1 (10·4)	28	6·1 (6·9)	23	15·6 (10·4)	17	1·8 (0·9)	26	7·8 (7·1)	31
	20 - 60	13 (10·3)	22	6·4 (6)	24	17·4 (11·6)	24	1·8 (0·9)	26	6·8 (5·5)	22
Facility Volume	1 - 6	12·6 (10·1)	22	5·2 (5·5)	17	15·1 (11·3)	16	1·2 (0·9)	12	8·5 (7·4)	32
	6 - 9	14·0 (11·7)	26	5·6 (5)	23	18·6 (14·2)	23	1·7 (0·9)	17	7·0 (5·3)	31
	9 - 20	11·5 (9·4)	18	5·4 (5·8)	19	12·0 (7·9)	7	1·6 (1·0)	20	5·3 (4·3)	12
	20 - 50	13·9 (10·4)	26	6·1 (6·1)	24	16·9 (10·8)	20	1·8 (0·9)	17	8·0 (6·0)	33
	50 - 600	13·2 (10·2)	23	6·5 (6·6)	25	16·6 (11·1)	22	1·9 (0·9)	29	7·0 (6·1)	23
Manufacturer	GE	13·7 (9·8)	27	5·8 (5·8)	21	18·0 (10·5)	26	1·8 (0·9)	19	8·2 (6·0)	31
	Philips	13·0 (11·1)	22	6·0 (5·6)	24	15·4 (11·8)	17	1·8 (0·9)	30	6·1 (5·4)	18
	Siemens	13·0 (10·2)	21	6·3 (7·1)	24	12·5 (9·8)	10	1·7 (0·8)	16	6·0 (5·4)	17
	Toshiba	13·1 (10·7)	23	8·2 (6·9)	39	19·5 (14·9)	27	2·2 (0·9)	54	8·4 (7·2)	37
Country	Switzerland	8 (5·1)	4	1·8 (1·6)	1	11·8 (7·0)	6	1·5 (0·5)	9	2·4 (1·4)	0
	Germany	8·4 (7·2)	8	3·1 (4·3)	8	10 (8·3)	7	1·5 (0·9)	9	2·4 (2·9)	2
	Netherlands	7·6 (5·8)	4	4·5 (4·3)	13	11·8 (4·9)	2	1·4 (0·6)	9	2·5 (2·4)	2
	United Kingdom	9·2 (8·5)	13	4·7 (3·7)	14	13·9 (8·4)	12	1·6 (0·7)	13	6·5 (5·4)	19
	USA	13·1 (9·7)	23	6·7 (6·6)	26	17·7 (11·4)	24	1·8 (0·9)	28	7·4 (5·8)	27
	Israel	19·6 (14·2)	44	6·4 (4·6)	26	22·8 (12·9)	37	1·8 (1·1)	17	7·3 (5·0)	18
	Japan	19·3 (14·2)	42	3·9 (5·3)	13	27·0 (17·7)	51	1·8 (1·0)	14	23·0 (20·0)	73

Table S2. Comparison of observed 75% effective doses (mSv) in the University of California San Francisco (UCSF) Dose Registry to published benchmark 75% doses· [4 5 25-29]

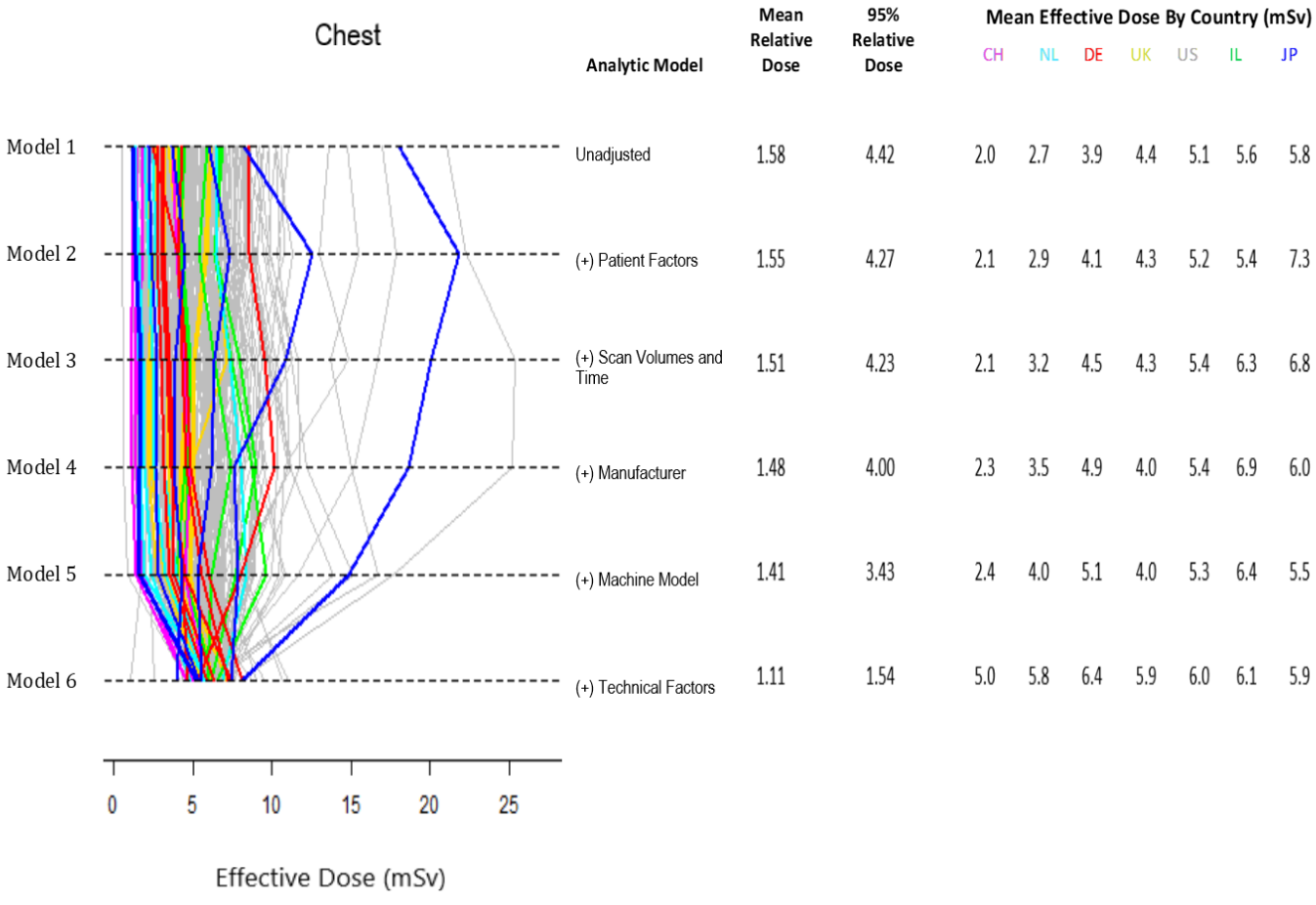
	Abdomen			Chest			Head		
	Dose Registry, mSv			Dose Registry, mSv			Dose Registry, mSv		
	75% Percentile Dose (95% CI) mSv		Published Dose mSv	75% Percentile Dose (95% CI)		Published Dose mSv	75% Percentile Dose (95% CI)		Published Dose mSv
Switzerland	10·3	(9·9-10·6)	10	2	(1·8-2·3)	3·0	1·6	(1·6-1·6)	1·7
Germany	10·3	(9·6-10·9)	8	3·9	(3·6-4·2)	6	1·9	(1·9-1·9)	1·9
Netherlands	8·9	(8·4-9·3)	12	5·8	(5·5-6·2)	5·3	1·7	(1·7-1·8)	1·8
United Kingdom	11·6	(10·8-12·5)	13	6·1	(5·8-6·5)	6·5	1·8	(1·8-1·9)	1·5
USA	16·8	(15·8-17·7)	18	8·1	(7·6-8·7)	8·4	2·3	(2·2-2·3)	1·9
Japan	25·4	(23·7-27·2)	25	4·7	(4·4-5·4)	8·3	1·8	(1·8, 1·9)	2·7

Data from published doses extracted were from all patients not selected by age or size or indication for scanning. When only protocol-specific doses were reported, a weighted average by protocol frequency was used to estimate mean dose by anatomic area. Effective doses that were not available were calculated from published dose length product values using published conversion factors. Comparison to benchmarks was not possible for Israel as no published dose data were identified.

Figure S1. Mean effective dose by machine with different levels of adjustment, other anatomic areas

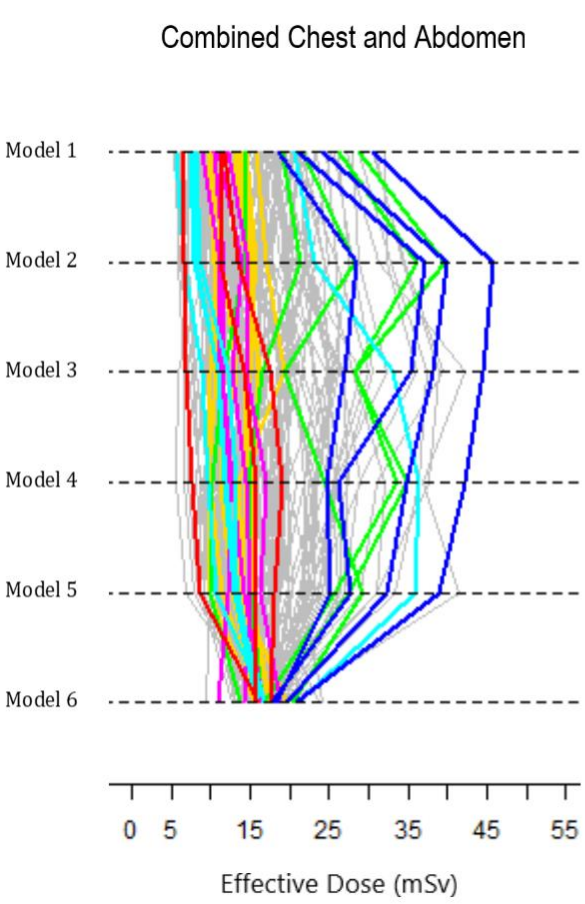
Chest (S1a), combined chest and abdomen, (S1b), head (S1c), pulmonary embolism (S1d). Model 1, CT examinations by machine, unadjusted. Subsequent adjustments were for: model 2, patient characteristics; model 3, institutional characteristics; model 4, manufacturer; model 5, machine model; model 6, technical parameters. Shown are mean relative effective dose and 95th percentile of relative dose for two randomly chosen machines with mean dose by country at the corresponding level of adjustment.

Figure S1a. Mean effective dose by machine with different levels of adjustment, chest



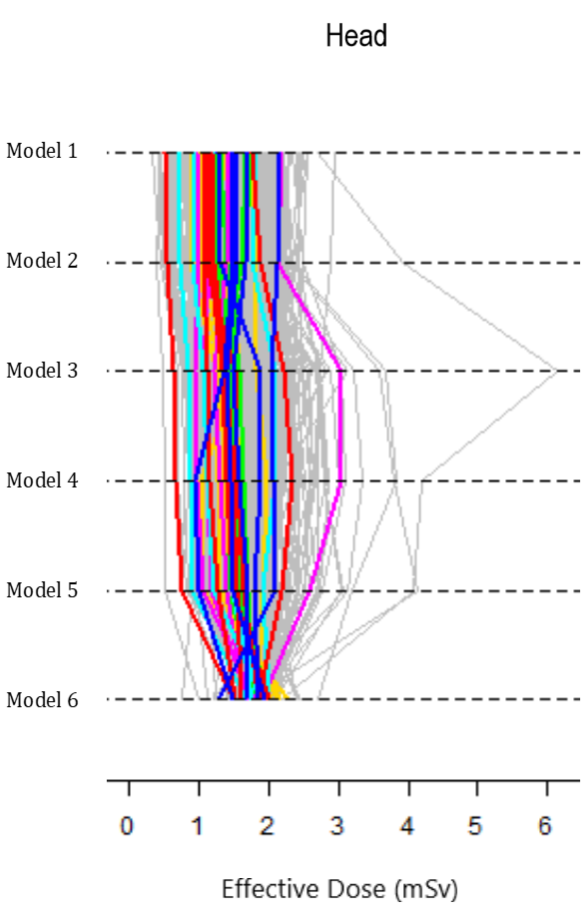
Analytic Model	Mean Relative Dose	95% Relative Dose	Mean Effective Dose By Country (mSv) CH	NL	DE	UK	US	IL	JP
Unadjusted	1.58	4.42	2.0	2.7	3.9	4.4	5.1	5.6	5.8
(+) Patient Factors	1.55	4.27	2.1	2.9	4.1	4.3	5.2	5.4	7.3
(+) Scan Volumes and Time	1.51	4.23	2.1	3.2	4.5	4.3	5.4	6.3	6.8
(+) Manufacturer	1.48	4.00	2.3	3.5	4.9	4.0	5.4	6.9	6.0
(+) Machine Model	1.41	3.43	2.4	4.0	5.1	4.0	5.3	6.4	5.5
(+) Technical Factors	1.11	1.54	5.0	5.8	6.4	5.9	6.0	6.1	5.9

Figure S1b. Mean effective dose by machine, combined chest and abdomen



Analytic Model	Mean Relative Dose	95% Relative Dose	Mean Effective Dose By Country (mSv)						
			CH	NL	DE	UK	US	IL	JP
Unadjusted	1.47	2.89	10.6	9.9	9.9	12.3	14.8	22.0	23.6
(+) Patient Factors	1.52	3.29	12.9	10.9	10.4	13.4	15.4	27.9	37.8
(+) Scan Volumes and Time	1.47	3.08	12.4	15.2	12.9	14.1	17.0	23.5	32.0
(+) Manufacturer	1.45	2.90	14.2	16.6	14.1	12.7	16.7	21.5	31.1
(+) Machine Model	1.40	2.60	14.4	17.2	14.2	13.2	16.5	21.5	31.1
(+) Technical Factors	1.11	1.42	15.2	17.3	16.4	16.5	16.5	17.1	19.2

Figure S1c. Mean effective dose by machine, head



Analytic Model	Mean Relative Dose	95% Relative Dose	Mean Effective Dose By Country (mSv)						
			CH	NL	DE	UK	US	IL	JP
Unadjusted	1.52	3.46	1.4	1.2	1.1	1.3	1.4	1.4	1.6
(+) Patient Factors	1.44	3.06	1.4	1.1	1.2	1.3	1.5	1.1	1.2
(+) Scan Volumes and Time	1.36	2.55	1.6	1.3	1.4	1.5	1.7	1.5	1.6
(+) Manufacturer	1.33	2.46	1.6	1.4	1.4	1.5	1.7	1.6	1.6
(+) Machine Model	1.30	2.26	1.6	1.4	1.5	1.5	1.7	1.6	1.6
(+) Technical Factors	1.09	1.46	1.8	1.8	1.7	2.0	1.8	1.9	1.6

Figure S1d. Mean effective dose by machine, suspected pulmonary embolism

