Online supplemental material

Van den Berk IAH, Kanglie MMNP, van Engelen TSR et al. OPTIMACT study group. Ultra-low-dose CT versus chest X-ray for patients suspected of pulmonary disease at the emergency department: a multicentre randomised clinical trial.

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Text S1 Radiation dose calculation ULDCT and CXR

Method

The effective dose of ULDCT was calculated by multiplying the Dose Length Product (DLP) of the CT-acquisition with a dose conversion factor for the chest.[1] Calculation of the effective dose of the CXR were based on Monte Carlo simulations with PCXMC 2.0 (STUK, Helsinki, Finland). Input parameters for the simulations are the Dose area Product (DAP) of the acquisitions, source to patient distance, beam collimation, kVp and beam filtration.

Result

The median ULDCT dose was 0.2 mSv (IQR 0.2 to 0.3 mSv). The median CXR dose was for portable anterior posterior (AP) CXR 0.02 mSv (IQR 0.02 to 0.03 mSv) and bucky CXR posterior anterior (PA) and lateral 0.05 mSv (IQR 0.03 to 0.07 mSv).

Reference

1. Schenzle JC, Sommer WH, Neumaier K, et al. Dual energy CT of the chest: how about the dose? *Invest Radiol* 2010;45(6):347-53. doi: 10.1097/RLI.0b013e3181df901d [published Online First: 2010/04/21]

Table S1 Excluded patients Amsterdam UMC and Spaarne Gasthuis (SG)

		Amsterdam UMC		Spaarne Gasthuis[a]	
Assessed for eligibility	**Total (N=4807)**	**ULDCT (N=1887)**	**CXR (N=1981)**	**ULDCT (N=475)**	**CXR (N=464)**
Randomised	2418	881	890	327	320
Excluded[b]	2389	1006	1091	148	144
Not meeting inclusion criteria	1286 (26.8)	611 (32.4)	617 (31.1)	19 (4.0)	39 (8.4)
Earlier participants	572	294	272	3	3
Barriers to follow-up data collection	232	85	130	7	10
Life expectancy less than one month	192	68	104	7	13
Incapacitated patients	178	84	80	2	12
Unable to undergo ULDCT or CXR	107	79	28	0	0
Pregnancy	5	1	3	0	1
Declined participation	237 (4.9)	119 (6.3)	115 (5.8)	2 (0.4)	1 (0.2)
Other reasons	866 (18.0)	276 (14.6)	359 (18.1)	127 (26.7)	104 (22.4)
Unknown	731	202	349	76	104
Transport problems	4	0	3	1	0
Waiting time too long	6	0	6	0	0
CT scanner not available	124	74	0	50	0
Electronic patient record error	1	0	1	0	0

ULDCT: Ultra-low-dose chest computed tomography, CXR: Chest X-ray.

[a] Due to privacy regulations the total number of patients assessed for eligibility, and the total number of patients excluded for randomization are incomplete. These numbers are composed of complete data (Amsterdam UMC, location AMC) and data from a random sample of non-included patients (Spaarne Gasthuis).

[b] Values are numbers (percentages).

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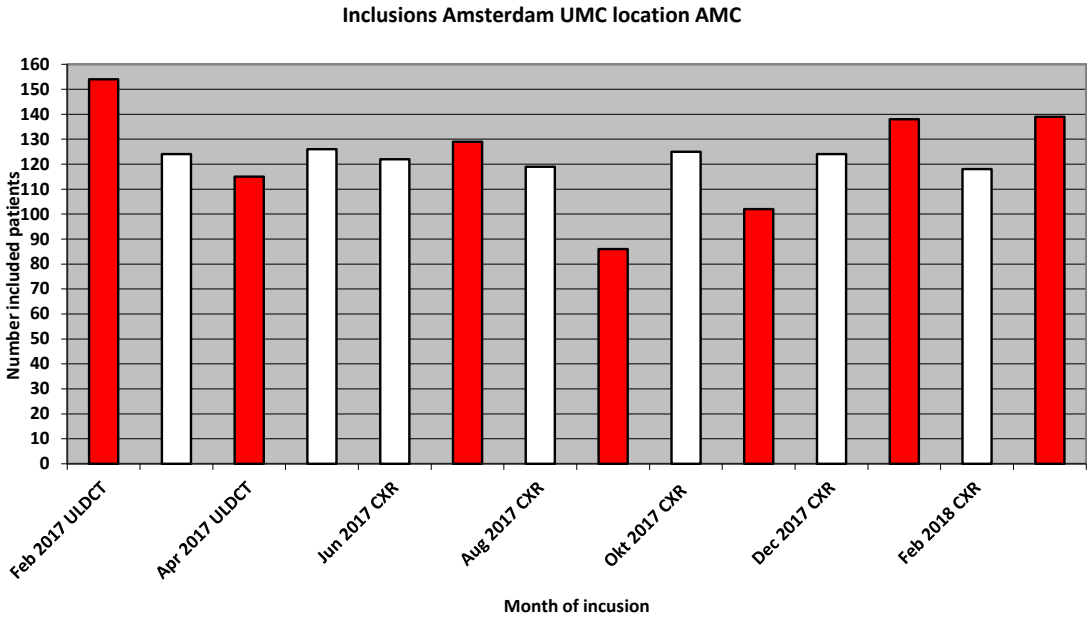

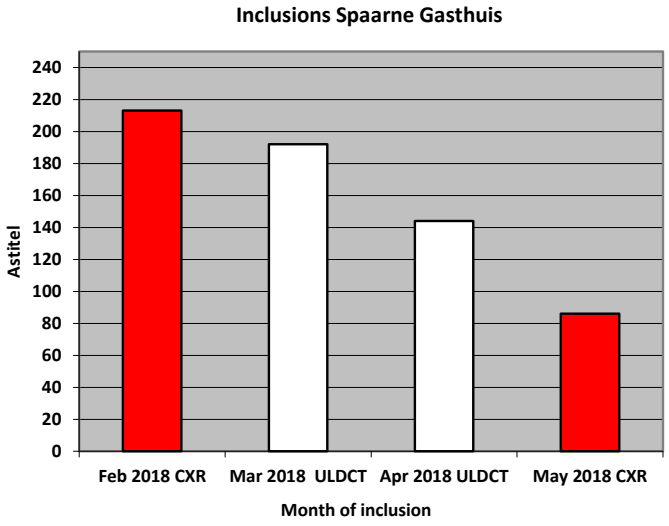

Figure S1 Inclusions per month and per inclusion site. Red bars: ultra-low-dose chest computed tomography (ULDCT), White bars: chest X-ray (CXR)

Text S2 Availability of prior imaging

The ULDCT and CXR were read with prior imaging if available. In the ULDCT group in 35.2% (425/1208) of patients a prior CXR was used during reading and in 31.7% (383/1208) a prior chest-CT. In the CXR group in 62.4% (788/1210) of patients a prior CXR was used during reading and in 11.9% (144/1210) a prior chest-CT. In patients in the CXR group, a prior CXR was more often used for comparison compared to the ULDCT group. This is in accordance with regular clinical practice and related to the two dimensional projection technique of CXR and the lower number of images.

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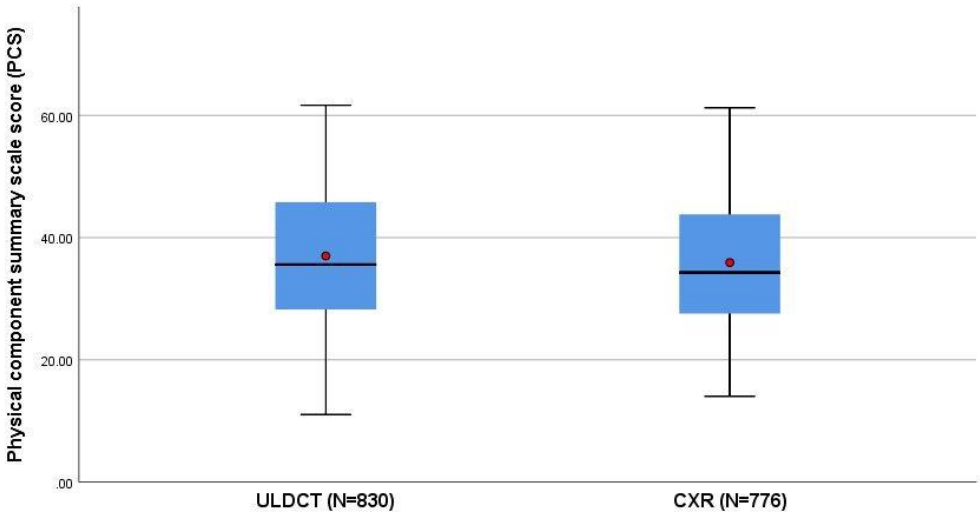

Figure S2 The distribution of the Physical component summary scale (PCS) scores.

ULDCT: Ultra-low-dose chest computed tomography, CXR: Chest X-ray

● Mean PCS score: ULDCT: 37.0 (95% CI 36.2 to 37.8), CXR: 35.9 (95% CI 35.2 to 36.7), difference 1.1 (95% lower CI: 0.003), histogram PCS in Supplement Figure S2.

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Text S3 Imputation and sensitivity analyses

Primary outcome: Sensitivity analyses

Sensitivity analysis including the imputed 109 PCS scores of incomplete questionnaires using age and sex as variables (excluding four questionnaires in the ULDCT group and one questionnaire in the CXR group that were sent back completely blank) showed a result similar to the primary analysis: mean PCS score 36.9 in the ULDCT group (n=892) versus 35.9 in the CXR group (n=823), a difference of 1.0 (one-sided 95% lower CI: -0.06). Non-inferiority of ULDCT to CXR within the prespecified 1-point margin was therefore shown in the non-imputed and imputed data. Multivariable linear regression analysis on the non-imputed data with imaging modality as a predictor as well as baseline characteristics (age, gender, comorbidity, presenting symptoms, clinical question on radiology application form) resulted in a mean difference in PCS scores of 0.9 (one-sided 95% lower CI: -0.1), also indicating non-inferiority of ULDCT.

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Table S2 Incidental findings: ULDCT versus CXR[a]

	ULDCT (n= 1200)[b]	CXR (n=1203)[b]	Effect estimate (95% CI)
Incidental findings	100 (8.3)	14 (1.2)	
Pulmonary nodules	54	7	
Pulmonary other	4	2	
Cardiovascular	19	3	
Upper abdomen	13	1	
Musculoskeletal	6	1	
Breast	3	0	
Neck	1	0	
Mediastinum	1	0	
In follow-up because of incidental findings 28 days	26 (2.2)	4 (0.3)	1.8 (1.0 to 2.7)
Pulmonary nodules	21	4	1.4 (0.6 to 2.2)
Pulmonary other	2	0	
Upper abdomen	3	0	

ULDCT: Ultra-low-dose chest computed tomography, CXR: Chest X-ray, CI: Confidence Interval.

[a] Values are numbers (percentages) unless otherwise specified.

[b] In imaging-per-protocol population.

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Table S3 Responders versus non-responders SF-12 questionnaire: baseline characteristics[a]

Characteristic	SF-12 returned (N=1720)	SF-12 not returned (N=698)	Standardized difference
Mean age (SD)[b], *y*	59.8 (17.5)	56.9 (20.1)	0.2
Female sex	854 (49.7)	346 (49.6)	0.2
Comorbidity			
Charlson Comorbidity Index[c] (IQR)	3.0 (1.0-5.0)	3.0 (1.0-5.0)	
Immunocompromised	392 (22.8)	139 (19.9)	7.2
Malignancy [b]	318 (18.5)	123 (17.6)	2.3
Diabetes[b]	320 (18.6)	155 (22.2)	8.9
Pulmonary disease			
Chronic obstructive pulmonary disease[b]	265 (15.4)	89 (12.8)	7.6
Asthma	180 (10.5)	70 (10.0)	1.4
Interstitial lung disease	42 (2.4)	15 (2.1)	2.0
Cystic fibrosis	22 (1.3)	6 (0.9)	4.1
Cardiac disease			
Myocardial infarction[b]	248 (14.4)	80 (11.5)	8.8
Chronic cardiac failure[b]	136 (7.9)	60 (8.6)	2.5
Neurological disease[b]	201 (11.7)	88 (12.6)	2.8
Kidney disease[b]	149 (8.7)	74 (10.6)	6.6
Thromboembolic disease	140 (8.1)	59 (8.5)	1.1

SD: standard deviation, IQR: interquartile range

[a] Values are numbers (percentages) unless otherwise specified.

[b] Variables included in the Charlson Comorbidity Index

[c] Charlson Comorbidity Index, excluding AIDS. Predicts 10-year survival in patients with multiple comorbidities

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Table S4 Responders versus non-responders SF-12 questionnaire: symptoms and clinical question after initial evaluation at Emergency Department[a]

Characteristic	SF-12 returned (N=1720)	SF-12 not returned (N=698)	Standardized difference
Presenting symptoms			
Dyspnoea	967 (56.2)	391 (56.0)	0.4
Cough	959 (55.8)	351 (50.3)	11.0
Fever	730 (42.4)	252 (36.1)	13.0
Thoracic pain	654 (38.0)	248 (35.5)	5.2
Sputum production	539 (31.3)	193 (27.7)	8.1
Haemoptysis	71 (4.1)	24 (3.4)	3.6
Confusion	57 (3.3)	34 (4.9)	7.9
Clinical question on radiology request form			
Pneumonia	1209 (70.3)	450 (64.5)	12.4
Pulmonary congestion	138 (8.0)	52 (7.4)	2.1
Bronchitis	120 (7.0)	45 (6.4)	2.1
Pneumothorax	60 (3.5)	45 (6.4)	13.6
Pleural effusion	46 (2.7)	35 (5.0)	12.2
Pulmonary tumour	15 (0.9)	5 (0.7)	1.8
Atelectasis	5 (0.3)	2 (0.3)	0.1
Pulmonary metastases	2 (0.1)	5 (0.7)	9.3
Other	125 (7.3)	44 (6.3)	3.8

SF-12: Short Form-12

[a] Values are numbers (percentages) unless otherwise specified.

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Table S5 Baseline characteristics complete[a]

Characteristics		**ULDCT (n=1208)**	**CXR (n=1210)**
Mean age (SD)[b], *y*		59.0 (18.1)	59.0 (18.6)
Female sex		613 (50.7)	587 (48.5)
Comorbidity			
Charlson Comorbidity Index[c] (IQR)		3.0 (1.0-5.0)	3.0 (1.0-5.0)
Immunocompromised		285 (23.6)	246 (20.3)
Malignancy[b]		229 (19.0)	222 (18.3)
Solid tumour[d]	Total	151 (13)	168 (14.0)
	Localized	88 (7.3)	92 (7.6)
	Metastasized	63 (5.2)	76 (6.3)
Malignant lymphoma[d]		46 (3.8)	33 (2.7)
Leukemia[d]		32 (2.6)	21 (1.7)
Diabetes[b]		230 (19.0)	245 (20.2)
No end organ damage[e]		173 (14.3)	177 (14.6)
With end organ damage[e]		57 (4.7)	68 (5.6)
Pulmonary disease			
Chronic obstructive pulmonary disease[c]		175 (14.5)	179 (14.8)
Asthma		141 (11.7)	109 (9.0)
Interstitial lung disease		29 (2.4)	28 (2.3)
Cystic fibrosis		14 (1.2)	14 (1.2)
Cardiac disease			
Myocardial infarction[b]		159 (13.2)	169 (14.0)
Chronic cardiac failure[b]		98 (8.1)	98 (8.1)
Neurological disease[b]		140 (11.6)	149 (12.3)
Cerebrovascular disease[b]		128 (10.6)	133 (11.0)
Dementia[b]		8 (0.7)	7 (0.6)
Hemiplegia[b]		4 (0.3)	9 (0.7)
Kidney disease[b]		104 (8.6)	119 (9.8)
Thromboembolic disease		92 (7.6)	107 (8.8)
Peripheral vascular disease[b]		66 (5.5)	88 (7.3)
Liver disease		44 (3.6)	46 (3.8)
Cirrhosis		24 (2.0)	22 (1.8)
Chronic hepatitis		20 (1.7)	24 (2.0)

ULDCT: Ultra-low-dose chest computed tomography, CXR: Chest X-ray, IQR: interquartile range

[a] Values are numbers (percentages) unless otherwise specified.

[b] Variables included in the Charlson Comorbidity Index

[c] Charlson Comorbidity Index, excluding AIDS. Predicts 10-year survival in patients with multiple comorbidities

[d] Within the past 5 years, except for chronic lymphatic leukaemia

[e] End organ damage: retinopathy, neuropathy, or nephropathy

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Table S6 Diagnosis at ED discharge and Day 28 diagnosis complete[a] [b]

Day 28 diagnosis	ULDCT (n=1161)		CXR (n=1151)	
	Diagnosis at ED discharge	Diagnosis at Day 28	Diagnosis at ED discharge	Diagnosis at Day 28
Extra-thoracic pathology	259 (22.3)	299 (25.8)	246 (21.4)	338 (29.4)
Community-acquired pneumonia	255 (22.0)	225 (19.4)	189 (16.4)	169 (14.7)
Thoracic pain of unknown origin	110 (9.5)	122 (10.5)	112 (9.7)	135 (11.7)
Fever of unknown origin	111 (9.6)	53 (4.6)	85 (7.4)	46 (4.0)
Lower respiratory tract infection other than pneumonia	101 (8.7)	121 (10.4)	100 (8.7)	116 (10.1)
COPD exacerbation	83 (7.1)	116 (10.0)	72 (6.3)	127 (11.0)
No definite diagnosis yet	78 (6.7)	-	108 (9.4)	-
Congestive heart failure	66 (5.7)	66 (5.7)	87 (7.6)	110 (9.6)
(Possible) influenza A/B[c]	53 (4.6)	96 (8.3)	22 (1.9)	73 (6.3)
Other thoracic pathology	57 (4.9)	60 (5.2)	66 (5.7)	63 (5.5)
Asthma exacerbation	51 (4.4)	75 (6.5)	34 (3.0)	49 (4.3)
Upper respiratory tract infection	49 (4.2)	52 (4.5)	48 (4.2)	64 (5.6)
Healthcare-associated pneumonia	4 (0.3)	50 (4.3)	8 (0.7)	37 (3.2)
Dyspnoea of unknown origin	32 (2.8)	26 (2.2)	48 (4.2)	23 (2.0)
Cardiac arrhythmia	32 (2.8)	34 (2.9)	34 (3.0)	36 (3.1)
Pleural effusion or empyema	22 (1.9)	27 (2.3)	12 (1.0)	33(2.9)
No pathology	22 (1.9)	21 (1.8)	30 (2.6)	20 (1.7)
Stable angina pectoris	16 (1.4)	17 (1.5)	13 (1.1)	7 (0.6)
Pulmonary embolism	14 (1.2)	18 (1.6)	29 (2.5)	28 (2.4)
Lung cancer or pulmonary metastases	8 (0.7)	19 (1.6)	8 (0.7)	21 (1.8)
Pericarditis	11 (0.9)	11 (0.9)	9 (0.8)	13 (1.1)
ACS with troponin	6 (0.5)	3 (0.3)	16 (1.4)	16 (1.4)
Interstitial lung disease	6 (0.5)	13 (1.1)	1 (0.1)	6 (0.5)
Sinusitis	9 (0.8)	11 (0.9)	9 (0.8)	9 (0.8)
Exacerbation CF	7 (0.6)	9 (0.8)	9 (0.8)	10 (0.9)
Pneumothorax	7 (0.6)	7 (0.6)	7 (0.6)	6 (0.5)
ACS without troponin	6 (0.5)	6 (0.5)	7 (0.6)	6 (0.5)
Aspiration pneumonia	8 (0.7)	6 (0.5)	5 (0.4)	4 (0.3)
Atelectasis	5 (0.4)	1 (0.09)	1 (0.1)	1 (0.09)
Pleuritis sicca	3 (0.3)	0 (0.0)	2 (0.2)	1 (0.09)
Mediastinal tumour	0 (0.0)	2 (0.2)	0 (0.0)	1 (0.09)
Acute chest syndrome	1 (0.1)	1 (0.09)	2 (0.2)	2 (0.2)
Radiation pneumonia	0 (0.0)	1 (0.09)	1 (0.1)	1 (0.09)

ULDCT: Ultra-low-dose chest computed tomography, CXR: Chest X-ray, COPD: Chronic obstructive pulmonary disease, CF: Cystic fibrosis, ACS: acute coronary syndrome

[a] Values are numbers (percentages).

[b] Patients could have more than one diagnosis.

[c] (Possible) influenza A/ B: at ED discharge a diagnosis of possible influenza A/B was assigned if a patient was treated for influenza A/B awaiting the results of the PCR test. At day 28 a diagnosis of influenza A/B was assigned to PCR positive patients accordingly.

van den Berk IAH, *et al. Thorax* 2023; 78:515–522. doi: 10.1136/thoraxjnl-2021-218337