

## Supplementary material

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**Table S1 Univariable analysis for modeling and testing with extravascular lung water index status**

Clinically relevant variables	MIMIC-CXR dataset (modeling)				External test dataset (testing)			
	Normal ELWI (N = 139)	Elevated ELWI (N = 156)	AUROC (95%CI)	P-value	Normal ELWI (N = 17)	Elevated ELWI (N = 46)	AUROC (95%CI)	P-value
Gender (men/women)	67/72	99/57	0.576 (0.520– 0.633)	<b>0.008</b>	12/5	28/18	0.549 (0.416– 0.681)	0.47
Admission age, years			0.618 (0.559– 0.676)	< 0.001			0.584 (0.446– 0.722)	0.23
≤ 30, n (%)	30 (21.6)	6 (3.8)			0 (0.0)	0 (0.0)		
> 30, ≤ 60, n (%)	52 (37.4)	60 (38.5)			6 (35.3)	24 (52.2)		
> 60, n (%)	57 (41.0)	90 (57.7)			11 (64.7)	22 (47.8)		
Comorbidities								
Congestive heart failure, n (%)	25 (18.0)	32 (20.5)	0.513 (0.468– 0.558)	0.58	3 (17.6)	10 (21.7)	0.520 (0.409– 0.632)	0.72
Chronic pulmonary disease, n (%)	54 (38.8)	71 (45.5)	0.533 (0.477– 0.590)	0.25	0 (0.0)	1 (2.2)	0.511 (0.490– 0.532)	0.32

Chronic renal disease, n (%)	2 (1.4)	13 (8.3)	0.534 (0.511–0.558)	<b>0.005</b>		3 (17.6)	6 (13.0)	0.523 (0.417–0.629)	0.67
Fluid balance, mL/kg	69.20 (24.63–150.85)	70.31 (17.39–134.14)	0.527 (0.460–0.593)	0.44		50.09 (6.92–54.17)	41.57 (5.24–82.88)	0.522 (0.375–0.668)	0.77
CVP, mmHg	13.00 (9.00–15.00)	13.00 (9.00–16.00)	0.528 (0.462–0.594)	0.41		12.00 (7.00–13.00)	12.00 (9.00–16.00)	0.598 (0.452–0.745)	0.19
Physical examinations									
Double lung crackles/wheeze, n (%)	38 (27.3)	68 (43.6)	0.581 (0.527–0.635)	<b>0.003</b>		9 (52.9)	33 (71.7)	0.594 (0.455–0.733)	0.19
General/lower extremity edema, n (%)	100 (71.9)	99 (63.5)	0.542 (0.489–0.596)	0.12		2 (11.8)	15 (32.6)	0.604 (0.500–0.709)	0.05
CXR labels (Uncertain-Zeros) <sup>#</sup>									
Cardiomegaly, n (%)	20 (14.4)	39 (25.0)	0.553 (0.508–0.598)	<b>0.02</b>		4 (23.5)	15 (32.6)	0.545 (0.415–0.671)	0.48
Lung edema, n (%)	28 (20.1)	42 (26.9)	0.534 (0.486–0.582)	0.17		3 (17.6)	23 (50.0)	0.662 (0.532–0.776)	0.008
Pleural effusion, n (%)	64 (46.0)	71 (45.5)	0.503 (0.446–0.560)	0.93		1 (5.9)	4 (8.7)	0.514 (0.385–0.642)	0.70
CXR labels (Uncertain-Ones) <sup>#</sup>									
Cardiomegaly, n (%)	29 (20.9)	45 (28.8)	0.540 (0.491–0.589)	0.11				0.545 (0.415–0.671)	0.48
Lung edema, n (%)	35 (25.2)	56 (35.9)	0.554 (0.501–0.606)	<b>0.045</b>				0.662 (0.532–0.776)	0.008
Pleural effusion, n (%)	69 (49.6)	73 (46.8)	0.514 (0.457–0.572)	0.63				0.514 (0.385–0.642)	0.70

<sup>#</sup>, CXR labels in the MIMIC-CXR dataset were assigned by CheXpert with binary mapping to 0 or 1 (Uncertain-Zeros model and Uncertain-Ones model). The significant P-value when modeling was indicated in bold. Data were expressed as medians (inter-quartile ranges) or frequencies (percentages). AUROC, area under the receiver operating characteristic curve; CI, confidence interval; CVP, central venous pressure; CXR, chest X-ray; ELWI, extravascular lung water

index; MIMIC-CXR, Medical Information Mart for Intensive Care-Chest X-Ray.

**Table S2 Univariable analysis for modeling and testing with global end diastolic volume index status**

Clinically relevant variables	MIMIC-CXR dataset (modeling)				External test dataset (testing)			
	Normal GEDI (N = 116)	Elevated GEDI (N = 179)	AUROC (95%CI)	P-value	Normal GEDI (N = 20)	Elevated GEDI (N = 43)	AUROC (95%CI)	P-value
Gender (men/women)	46/70	120/59	0.637 (0.579– 0.692)	< 0.001	6/14	34/9	0.745 (0.620– 0.847)	< 0.001
Admission age, years			0.727 (0.673– 0.777)	< 0.001			0.591 (0.460– 0.713)	0.18
≤ 30, n (%)	31 (26.7)	5 (2.8)			0 (0.0)	0 (0.0)		
> 30, ≤ 60, n (%)	54 (46.6)	58 (32.4)			12 (60.0)	18 (41.9)		
> 60, n (%)	31 (26.7)	116 (64.8)			8 (40.0)	25 (58.1)		
Comorbidities								
Congestive heart failure, n (%)	16 (13.8)	41 (22.9)	0.546 (0.487– 0.603)	0.04	6 (30.0)	7 (16.3)	0.569 (0.438– 0.693)	0.25
Chronic pulmonary disease, n (%)	48 (41.4)	77 (43.0)	0.508 (0.450– 0.567)	0.78	1 (5.0)	0 (0.0)	0.525 (0.395– 0.652)	0.32
Chronic renal disease, n (%)	0 (0.0)	15 (8.4)	0.542 (0.483– 0.600)	< 0.001	4 (20.0)	5 (11.6)	0.542 (0.412– 0.668)	0.42
Fluid balance, mL/kg	68.93 (25.58– 144.82)	69.47 (16.06– 134.78)	0.529 (0.470– 0.587)	0.40	44.81 (-11.01– 74.00)	45.53 (6.94– 78.40)	0.544 (0.414– 0.670)	0.60
CVP, mmHg	13.00 (10.00– 16.00)	12.00 (9.00– 16.00)	0.531 (0.472– 0.589)	0.36	10.50 (9.00– 12.00)	13.00 (8.00– 16.00)	0.599 (0.468– 0.720)	0.17

Physical examinations									
Double lung crackles/wheeze, n (%)	39 (33.6)	67 (37.4)	0.519 (0.460–0.577)	0.50	15 (75.0)	27 (62.8)	0.561 (0.430–0.686)	0.33	
General/lower extremity edema, n (%)	83 (71.6)	116 (64.8)	0.534 (0.475–0.592)	0.22					
CXR labels (Uncertain-Zeros) <sup>#</sup>									
Cardiomegaly, n (%)	16 (13.8)	43 (24.0)	0.551 (0.492–0.609)	<b>0.02</b>	8 (40.0)	11 (25.6)	0.572 (0.441–0.696)	0.27	
Lung edema, n (%)	16 (13.8)	54 (30.2)	0.582 (0.523–0.639)	< <b>0.001</b>	10 (50.0)	16 (37.2)	0.564 (0.433–0.689)	0.35	
Pleural effusion, n (%)	52 (44.8)	83 (46.4)	0.508 (0.449–0.566)	0.80	3 (15.0)	2 (4.7)	0.552 (0.421–0.677)	0.24	
CXR labels (Uncertain-Ones) <sup>#</sup>									
Cardiomegaly, n (%)	22 (19.0)	52 (29.1)	0.550 (0.492–0.608)	<b>0.04</b>			0.572 (0.441–0.696)	0.27	
Lung edema, n (%)	21 (18.1)	70 (39.1)	0.605 (0.547–0.661)	< <b>0.001</b>			0.564 (0.433–0.689)	0.35	
Pleural effusion, n (%)	55 (47.4)	87 (48.6)	0.506 (0.447–0.564)	0.84			0.552 (0.421–0.677)	0.24	

<sup>#</sup>, CXR labels in the MIMIC-CXR dataset were assigned by CheXpert with binary mapping to 0 or 1 (Uncertain-Zeros model and Uncertain-Ones model). The significant P-value when modeling was indicated in bold. Data were expressed as medians (inter-quartile ranges) or frequencies (percentages). AUROC, area under the receiver operating characteristic curve; CI, confidence interval; CVP, central venous pressure; CXR, chest X-ray; GEDI, global end diastolic volume index; MIMIC-CXR, Medical Information Mart for Intensive Care-Chest X-Ray.

**Table S3 Comparisons of deep learning model with other models**

Comparisons with other models	Cohorts	ELWI			GEDI		
		AUROC difference	SE	P-value	AUROC difference	SE	P-value
Clinical model	Primary	0.180	0.077	<b>0.02</b>	-0.057	0.068	0.40
	Test	0.135	0.103	0.19	0.134	0.105	0.20
Semantic label model (Uncertain-Zeros) <sup>#</sup>	Primary	0.364	0.085	< <b>0.001</b>	0.101	0.084	0.23
	Test	0.206	0.106	0.05	0.097	0.104	0.35
Semantic label model (Uncertain-Ones) <sup>#</sup>	Primary	0.340	0.085	< <b>0.001</b>	0.156	0.088	0.08
	Test	0.046	0.098	0.64	0.134	0.105	0.20
Clinical + Semantic label model (Uncertain-Zeros) <sup>#</sup>	Primary	0.187	0.077	<b>0.02</b>	0.004	0.075	0.96
	Test	0.036	0.098	0.71	0.095	0.104	0.36
Clinical + Semantic label model (Uncertain-Ones) <sup>#</sup>	Primary	0.221	0.080	<b>0.005</b>	0.022	0.077	0.78
	Test	0.213	0.106	<b>0.04</b>	0.097	0.104	0.35

<sup>#</sup>, CXR labels in the MIMIC-CXR dataset were assigned by CheXpert with binary mapping to 0 or 1 (Uncertain-Zeros model and Uncertain-Ones model). The significant P-value was indicated in bold. AUROC, area under the receiver operating characteristic curve; DL, deep learning; ELWI, extravascular lung water index; GEDI, global end diastolic volume index; SE, standard error.