ONLINE DATA SUPPLEMENT

Table E1. Cross correlation matrix of changes of the three different measurements (VAS, Dyspnoea-12 and Borg score) of breathlessness post-drainage (vs. baseline).

Pearson correlation coefficient	△VAS	△ D12 (total)	△D12 physical	△D12 affective	△BORG (pre-6MWT)	△BORG (post-6MWT)
△VAS	1.00	-0.52	-0.59	-0.35	-0.03	-0.01
△D12 (total)	-0.52	1.00	-0.93	-0.89	-0.08	-0.03
△D12 physical	-0.59	-0.93	1.00	-0.66	-0.09	-0.03
△D12 affective	-0.35	-0.89	-0.66	1.00	-0.04	-0.02
△BORG (pre-6MWT)	-0.03	-0.08	-0.09	-0.04	1.00	-0.28
△BORG (post-6MWT)	-0.01	-0.03	-0.03	-0.02	-0.28	1.00

△ = post-drainage measurements minus pre-drainage measurements.
Pre-6MWT represented measurement before 6-minute walk test; Post-6MWT represented measurements after maximal exertion at 6-minute walk test.

Table E2: Variables considered for modelling the different subsets.

Model Number	**Subset description**	**Variables considered**
1	Pre-VAS only	Pre-VAS
2	ALL VARIABLES	ALL VARIABLES
3	Demographics only	Gender
		Smoking
		Age
4	Clinical variables only	Previous drainages
		Procedure type
		Diagnosis
		Total volume drained (mL)
		Days since detection
		Serum Albumin
		Serum Hb
		pH
		ECOG
5	PROMs and demographics	D12 Affective
		D12 Physical
		Dyspnoea12
		VAS
		Age
		Gender
		Smoking
6	PROMs (excluding pre-VAS) and demographics	D12 Affective
		D12 Physical
		Dyspnoea 12
		Age
		Gender
		Smoking
7	Radiology only	Effusion grade
		Side of effusion
		Loculations
		Mediastinal shift
		Diaphragmatic appearance
		Diaphragm Movement
8	Physiology only	FiO2
		HR
		RR
		SpO2
		6MWT
		FEV1 % predicted
		FVC % predicted

Model Number	Subset description	Variables considered
9	Physiology and radiology	Effusion grade
		Side of effusion
		Loculations
		Mediastinal shift
		Diaphragmatic appearance
		Diaphragm Movement
		FiO2
		HR
		RR
		SpO2
		6MWT
		FEV1 % predicted
		FVC % predicted
10	Demographics and clinical	Gender
		Smoking
		Age
		Previous drainages
		Procedure type
		Diagnosis
		Total volume drained (mL)
		Days since detection
		Serum Albumin
		Serum Hb
		pH
		ECOG
11	Demographics, clinical and PROMs (excluding pre-VAS).	Gender
		Smoking
		Age
		Previous drainages
		Procedure type
		Diagnosis
		Total volume drained (mL)
		Days since detection
		Serum Albumin
		Serum Hb
		pH
		ECOG
		D12 Affective
		D12 Physical
		Dyspnoea 12
12	Demographics, clinical and PROMs	Gender
		Smoking

Model Number	Subset description	Variables considered
		Age
		Previous drainages
		Procedure type
		Diagnosis
		Total volume drained (mL)
		Days since detection
		Serum Albumin
		Serum Hb
		pH
		ECOG
		D12 Affective
		D12 Physical
		Dyspnoea12
		pre-VAS
13	Demographics, clinical, physiology and radiology.	Effusion grade
		Side of effusion
		Loculations
		Mediastinal shift
		Diaphragmatic appearance
		Diaphragm Movement
		ECOG
		FiO2
		HR
		RR
		SpO2
		6MWT
		FEV1 % predicted
		FVC % predicted
		Gender
		Smoking
		Age
14	ALL VARIABLES (except pre-VAS)	ALL VARIABLES (except pre-VAS)

PROM – Patient Reported Outcome Measure

Table E3. Comparisons of various subsets of baseline characteristics to determine which provide the best model for prediction of change in VAS. Models fitted using logistic regression and a change of 9 mm or more as a positive response.
There were 121 responders and 24 non-responders

Model Number	Subset description	Variables selected by AIC (n=135)	AUC	Specificity	Sensitivity	PPV	NPV
1	Pre-VAS only	Pre-VAS	0.77	0.81	0.60	0.94	0.27
2	All variables	Respiratory rate; Dysponea-12 (D-12); Days since detection; pH; Diaphragm movement; Previous Drainages; Pre-VAS	0.86	0.81	0.77	0.96	0.40
3	Demographics only	Age	0.65	0.76	0.57	0.93	0.25
4	Clinical variables only	Total volume drained (mL); Days since detection;	0.70	0.62	0.79	0.92	0.35
5	Patient reported outcome measures and demographics	Pre-VAS; Age	0.78	0.76	0.74	0.94	0.35
6	Patient reported outcome measures (excluding pre-VAS) and demographics	D-12 Physical; Age	0.69	0.67	0.69	0.92	0.29
7	Radiology only	NONE SELECTED	NA	NA	NA	NA	NA
8	Physiology only	FEV1 % predicted; Heart rate	0.64	0.67	0.64	0.91	0.25

9	Physiology and radiology	FEV1 % predicted; Heart rate	0.64	0.67	0.64	0.91	0.25
10	Demographics and clinical	Previous Drainages; Age	0.70	0.67	0.70	0.92	0.29
11	Demographic, clinical and patient reported outcome measures (excluding pre-VAS).	Previous Drainages; D-12 Physical; Age	0.72	0.62	0.82	0.92	0.38
12	Demographic, clinical and patient reported outcome measures (pre-VAS, D12 and Borg)	D-12; Serum Hb; pH; Age; Previous Drainages; Pre-VAS	0.83	0.67	0.92	0.94	0.61
13	Demographics, clinical, physiology and radiology.	FEV1 % predicted; Age; Heart rate	0.67	0.67	0.62	0.91	0.25
14	All variables (except pre-VAS)	FEV1 % predicted; Age; Previous Drainages	0.71	0.71	0.66	0.93	0.28

Table E4. Comparisons of various subsets of baseline characteristics to determine which provide the best model for prediction of change in VAS. Models fitted using logistic regression and a change of 19 mm or more as a positive response.
There were 102 responders and 43 non-responders

Model Number	Subset description	Variables selected by AIC (n=135)	AUC	Specificity	Sensitivity	PPV	NPV
1	Pre-VAS only	Pre-VAS	0.81	0.62	0.89	0.85	0.71
2	All variables	Diagnosis; Serum Albumin; Diaphragm Movement; pH; Pre-VAS	0.85	0.75	0.80	0.88	0.61
3	Demographics only	NONE SELECTED	NA	NA	NA	NA	NA
4	Clinical variables only	Total volume drained (mL); Days since detection; ECOG	0.68	0.68	0.62	0.82	0.43
5	Patient reported outcome measures and demographics	Pre-VAS	0.81	0.62	0.89	0.85	0.71
6	Patient reported outcome measures (excluding pre-VAS) and demographics	D-12 Physical	0.70	0.68	0.60	0.81	0.42
7	Radiology only	Loculations; Side of effusion; Effusion grade	0.65	0.57	0.68	0.79	0.43
8	Physiology only	FEV1 % predicted; Respiratory rate	0.64	0.62	0.60	0.79	0.40
9	Physiology and radiology	FEV1 % predicted; Respiratory rate	0.64	0.62	0.60	0.79	0.40
10	Demographics and clinical	Total volume drained (mL);	0.68	0.68	0.62	0.82	0.43

		Days since detection; ECOG					
11	Demographic, clinical and patient reported outcome measures (excluding pre-VAS).	Total volume drained (mL); ECOG; pH; D12 Physical	0.75	0.62	0.78	0.83	0.54
12	Demographic, clinical and patient reported outcome measures (pre-VAS, D12 and Borg)	Total volume drained (mL); pH; Pre-VAS	0.83	0.68	0.86	0.86	0.68
13	Demographics, clinical, physiology and radiology.	FEV1 % predicted; Respiratory rate	0.64	0.62	0.60	0.79	0.40
14	All variables (except pre-VAS)	SpO2; Serum Albumin; Total volume drained (mL); pH; D12 Physical	0.76	0.70	0.78	0.86	0.57

Table E5: Comparisons of various subsets of baseline characteristics to determine which provide the best model for prediction of change in VAS. Models fitted using logistic regression and VAS a continuous scale.

Model Number	Subset description	Variables selected by AIC (n=135)	R-squared	Adjusted R-squared	RMSE
1	Pre-VAS only	Pre-VAS	0.50	0.49	17.07
2	All variables	Move D12 Affective D12 Physical Dyspnoea12 Distance Days since detection Respiratory rate pH Pre-VAS	0.57	0.53	15.86
3	Demographics only	Age	0.02	0.01	23.86
4	Clinical variables only	Serum Hb Procedure type	0.05	0.02	23.52
5	Patient reported outcome measures and demographics	Pre-VAS	0.50	0.49	17.07
6	Patient reported outcome measures (excluding pre-VAS) and demographics	Age D12 Physical	0.19	0.17	21.71

7	Radiology only	Loculations	0.02	0.01	23.87
8	Physiology only	FVC % predicted	0.04	0.03	23.64
9	Physiology and radiology	FVC % predicted Loculations	0.05	0.04	23.46
10	Demographics and clinical	Age Procedure type	0.05	0.03	23.5
11	Demographics, clinical and patient reported outcome measures (excluding pre-VAS).	Age Previous drainages D12 Physical	0.21	0.19	21.43
12	Demographics, clinical and patient reported outcome measures (pre-VAS, D12 and Borg)	Days since detection pH Pre-VAS	0.53	0.52	16.57
13	Demographics, clinical, physiology and radiology.	FVC % predicted Loculations	0.05	0.04	23.46
14	All variables (except pre-VAS)	Age Previous drainages D12 Physical	0.21	0.19	21.43

Table E6: Volume drained, pre-drainage diaphragm appearance and movement, spirometry, 6-minute walk distance, and VAS score pre- and post-drainage for each Light's grade of effusion (pre-drainage) in participants with unilateral pleural effusion

Pre-Effusion Grade	Volume drained, ml	Pre-Diaphragm shape, n (%)			Pre-Diaphragm movement, n (%)		Pre-VAS ,mm	Post-VAS, mm	Pre-FEV_1 pred, %	Post-FEV_1 pred, %	Pre-FVC pred,%	Post-FVC pred,%	Pre-6MWD, m	Post-6MWD, m
		Domed	Flattened	Inverted	Normal[#]	Abnormal[*]								
Grade 2 n=10	1308 (499)	7 (70)	1 (10)	2 (20)	8 (80)	2 (20)	40 (24)	75 (25)	44 (18)	50 (19)	58 (26)	67 (22)	262 (141)	296 (154)
Grade 3 n=44	1488 (735)	32 (73)	10 (23)	2 (4)	33 (75)	11 (25)	48 (25)	71 (18)	54 (17)	59 (16)	55 (17)	58 (15)	289 (143)	311 (150)
Grade 4 n=38	2180 (1083)	15 (40)	18 (47)	5 (13)	15 (39)	23 (61)	47 (18)	75 (16)	42 (12)	53 (17)	43 (14)	54 (17)	242 (130)	279 (144)
Grade 5 n=30	3132 (1740)	2 (7)	15 (50)	13 (43)	1 (3)	29 (97)	40 (19)	70 (18)	35 (8)	46 (11)	35 (9)	45 (12)	196 (169)	244 (190)

All data were presented as mean (SD) and count (%); Pre = Pre-drainage; Post = Post drainage

[#] Normal diaphragm movement also included participants with reduced diaphragm movement

[*] Abnormal diaphragm movement consists of participants with no movement and paradoxical movement

We did not perform a similar analysis in patients with bilateral effusion as there were only 23 patients and majority (16/23) had a Grade 3 pleural effusion.

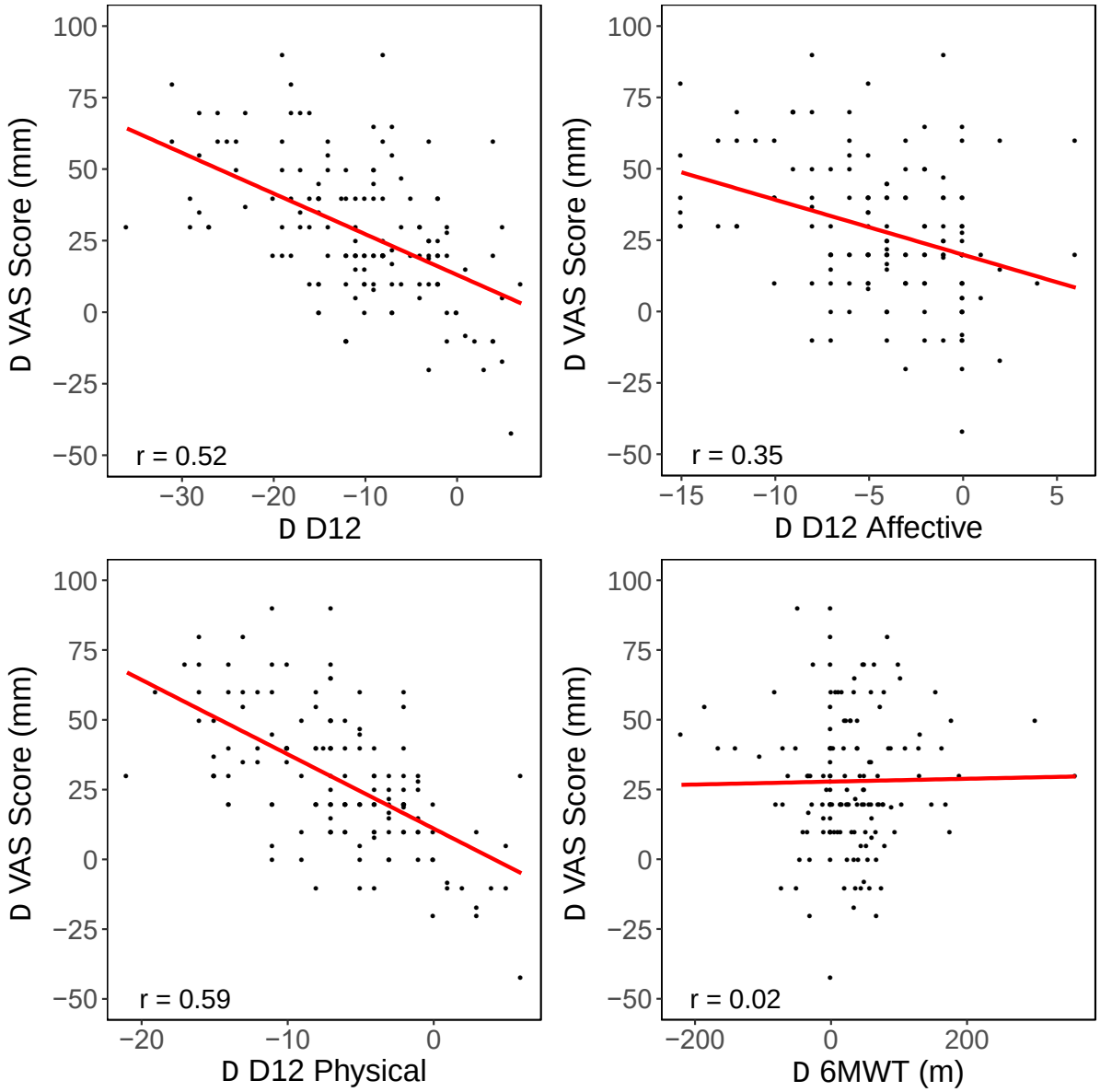

Figure E1: Relationship between change in VAS score and change in D12 score (top left panel), change D12 affective (top right panel), change in D12 physical (bottom left panel) change in 6-minute walk test (bottom right panel).

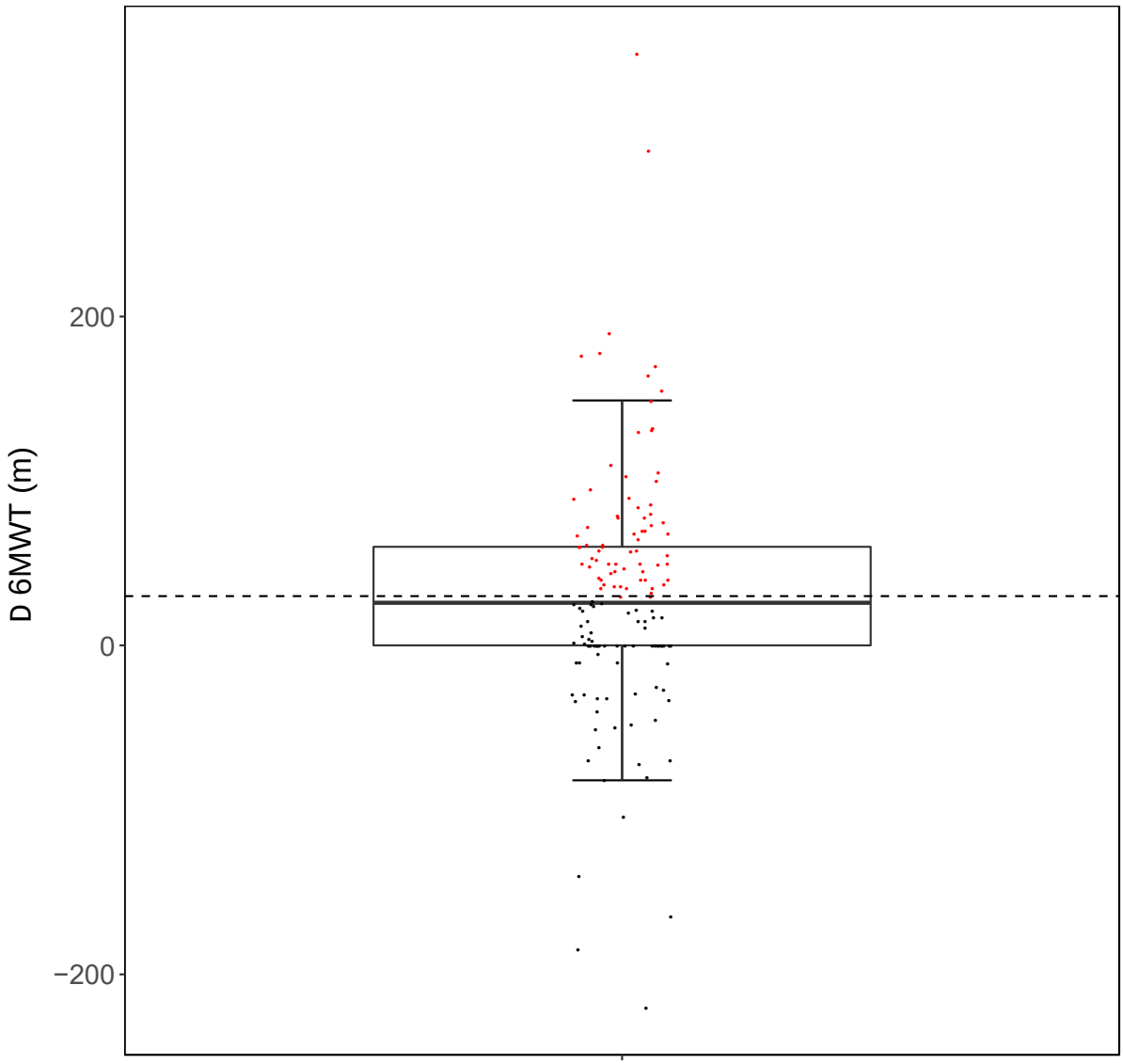

Figure E2: Change in 6-minute walk test distance from pre to post drainage. Red dots indicate those individuals who have an increase of at least 30 m.

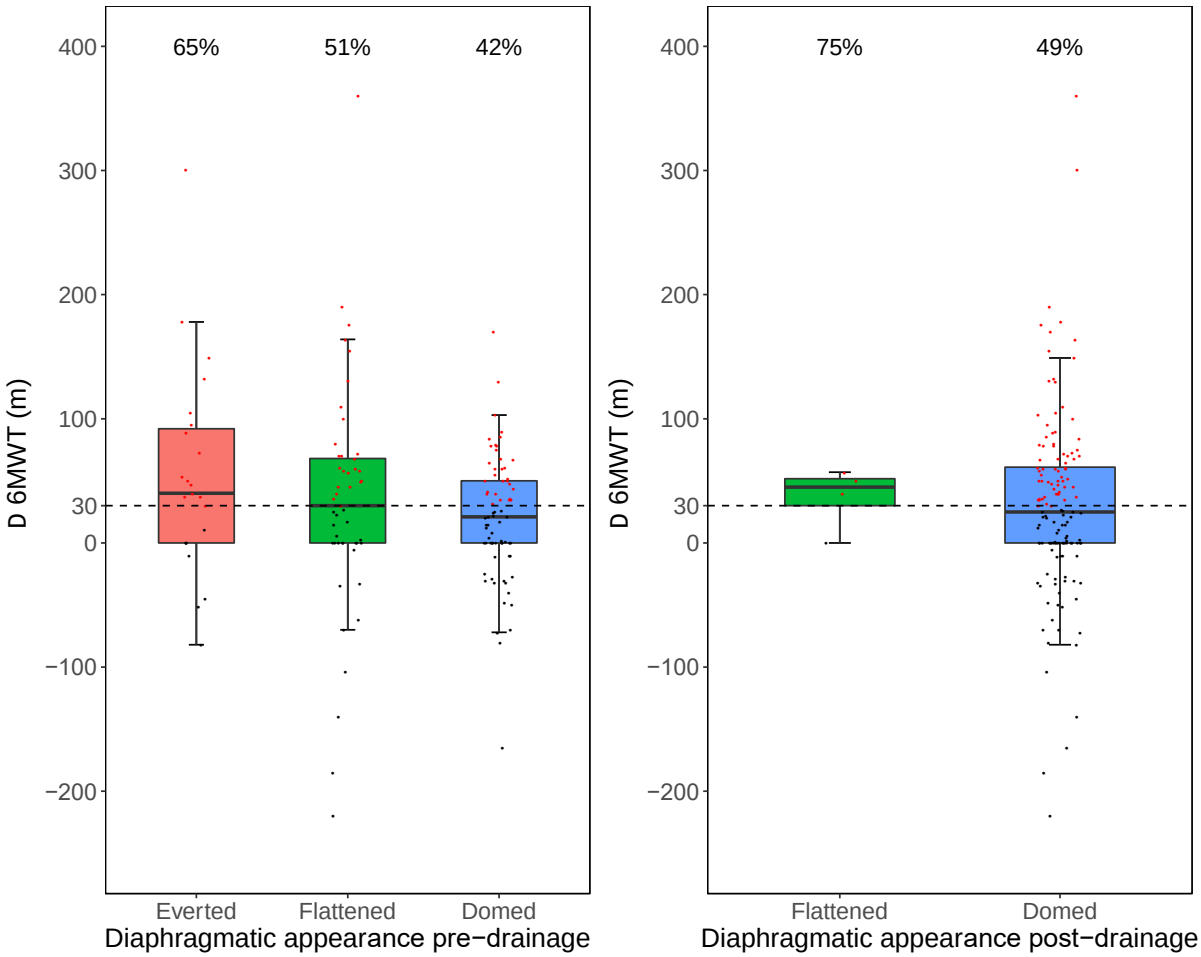

Figure E3: Change in 6-minute walk test by diaphragmatic appearance pre-drainage (left panel) and post drainage (right panel). Percentages at the top describe the proportion of participants who had a change in 6-minute walk distance of 30 m or more post-drainage.