Supplementary material

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Supplementary figures

Supplementary Table 1: Characteristics of patients that received IMV following CPAP

		All	CPAP <5 days	CPAP ≥5 days
	n	544	389	155
Age (years)	Median (IQR)	60 (52,67)	59 (52,66)	62 (55,69)
Sex	Female	159 (29.2%)	122 (31.4%)	37 (23.9%)
	Male	385 (70.8%)	267 (68.6%)	118 (76.1%)
Socioeconomic status quintile (SIMD)	1 - Most deprived	165 (31.8%)	120 (32.0%)	45 (31.2%)
	2	122 (23.5%)	93 (24.8%)	29 (20.1%)
	3	90 (17.3%)	61 (16.3%)	29 (20.1%)
	4	89 (17.1%)	63 (16.8%)	26 (18.1%)
	5 - Least deprived	53 (10.2%)	38 (10.1%)	15 (10.4%)
Ethnicity	White	468 (92.9%)	331 (92.2%)	137 (94.5%)
	Other	36 (7.1%)	28 (7.8%)	8 (5.5%)
Comorbidity count	0	335 (61.6%)	240 (61.7%)	95 (61.3%)
	1	114 (21.0%)	86 (22.1%)	28 (18.1%)
	2 plus	95 (17.5%)	63 (16.2%)	32 (20.6%)
Comorbidities	Cardiovascular	59 (10.8%)	43 (11.1%)	16 (10.3%)
	Respiratory	57 (10.5%)	41 (10.5%)	16 (10.3%)
	Diabetes Mellitus	59 (10.8%)	46 (11.8%)	13 (8.4%)
	Cancer	39 (7.2%)	22 (5.7%)	17 (11.0%)
	Other	66 (12.1%)	46 (11.8%)	20 (12.9%)
Emergency hospital admissions in previous year	0	406 (74.6%)	293 (75.3%)	113 (72.9%)
	1	111 (20.4%)	77 (19.8%)	34 (21.9%)
	2 plus	27 (5.0%)	19 (4.9%)	8 (5.2%)
Clinical frailty score (CFS)	Non-frail	360 (66.2%)	247 (63.5%)	113 (72.9%)
	Vulnerable	67 (12.3%)	48 (12.3%)	19 (12.3%)
	Frail	40 (7.4%)	30 (7.7%)	10 (6.5%)
	Not known	77 (14.2%)	64 (16.5%)	13 (8.4%)
Time from hospital admission to critical care admission (days) Median (IQR)		0 (0,2)	0 (0,2)	1 (0,2)

Respiratory support prior to IMV

HFNO prior to IMV, n (%)	261 (48.0%)	163 (41.9%)	98 (63.2%)
CPAP and HFNO duration, Median (IQR)	4 (2,7)	3 (2,4)	7 (6,10)
CPAP duration, Median (IQR)	2 (1,5)	2 (1,3)	6 (4.5,8)
HFNO duration, Median (IQR)	2 (1,4)	2 (1,4)	3 (2,4)

P:F ratio

Available, n (%)	194 (35.7%)	163 (41.9%)	31 (20.0%)
Median (IQR)	10.5 (8.7,13.8)	10.3 (8.6,13.7)	11.3 (8.9,14.3)
>13.3kPa, n (%)	54 (27.8%)	45 (27.6%)	9 (29.0%)
≤13.3kPa, n (%)	140 (72.2%)	118 (72.4%)	22 (71.0%)

CPAP indicates first set of consecutive days of CPAP prior to invasive ventilation, death or critical care discharge. 25 records have an unknown SIMD quintile. 40 records have unknown ethnicity. Percentages for organ support, advanced respiratory support, non-invasive ventilation, cardiovascular support and renal replacement therapy are based on complete recording of this data corresponding to admission date - 0 record(s) are currently missing. *Indicates cell suppression/merging due to disclosure risk. ** indicates data for only patients who required HFNO during their stay. ***PF ratio only available for patient admitted to Level 3 or Level 2/3 areas on first day of critical care stay and percentages given for those with data available.

Supplementary Table 2: Factors associated with hospital mortality following invasive mechanical ventilation (individual comorbidities)

	Univariable model		Multivariable model	
	Odds ratio (95% CI)	p-value	Odds ratio (95% CI)	p-value
Protracted CPAP prior to IMV	1.94 (1.25,3.01)	0.003	1.44 (0.86,2.4)	0.165
Age	1.06 (1.04,1.08)	<0.001	1.07 (1.05,1.1)	<0.001
Male sex	1.59 (1.07,2.38)	0.022	1.38 (0.89,2.16)	0.153
Ethnicity (ref= White)	0.65 (0.33,1.29)	0.218	1.07 (0.47,2.47)	0.866
SIMD (ref=5 - Least deprived)				
4	1.95 (0.5,2.23)	0.897	0.93 (0.41,2.11)	0.860
3	1.01 (0.5,2.04)	0.986	0.85 (0.39,1.86)	0.682
2	1.01 (0.51,2.02)	0.970	1.03 (0.48,2.2)	0.938
1 - Most deprived	0.82 (0.43,1.57)	0.545	0.92 (0.45,1.89)	0.814
Comorbidities				
Cardiovascular disease	1.54 (0.84,2.84)	0.161	1.17 (0.57,2.43)	0.664
Respiratory disease	1.02 (0.55,1.89)	0.938	0.93 (0.46,1.9)	0.847
Diabetes Mellitus	1 (0.57,1.76)	0.997	0.99 (0.51,1.94)	0.979
Cancer	0.96 (0.48,1.92)	0.916	0.66 (0.3,1.44)	0.297
Other comorbidity	1.47 (0.82,2.65)	0.193	1.44 (0.72,2.9)	0.305
PF ratio (ref=Unavailable)				
>13.3kPa	1.09 (0.59,2.02)	0.790	1.15 (0.54,2.43)	0.713
≤13.3kPa	0.99 (0.65,1.49)	0.944	0.86 (0.53,1.39)	0.528
Prior emergency Admission	0.89 (0.59,1.34)	0.569	0.8 (0.49,1.3)	0.364
Frailty (ref= Non-frail)				
Vulnerable/Frail	0.98 (0.63,1.52)	0.925	0.79 (0.48,1.3)	0.350
Natural Spline Admission Date				
1	2.22 (1,4.93)	0.051	2.28 (0.94,5.52)	0.067
2	0.58 (0.12,2.80)	0.493	1.03 (0.18,5.95)	0.973
3	1.50 (0.38,5.90)	0.558	2.18 (0.44,10.76)	0.335
4	0.88 (0.13,6.21)	0.899	1.36 (0.16,11.74)	0.780
5	7.52 (2.11,26.72)	0.002	15.13 (3.51,65.18)	0.000

Logistic regression models showing odds ratios of various factors associated with Ultimate hospital mortality following IMV. Number of Observations = 540. Multiple imputation has been used to supplement missing data for Ultimate Hospital Mortality (n=32 (5.9 %)), SIMD (n=24 (4.4 %)), Frailty (n=77 (14.3 %)) and Ethnicity (n=40 (7.4 %). Admission date was assessed using a Natural Spline with 5 degrees of freedom.

Supplementary Table 3: Characteristics of patients that received IMV following CPAP comparing <7 days and ≥ 7 days CPAP

		All	CPAP <7 days	CPAP ≥7 days
	n	1961	1547	414
Age (years)	Median (IQR)	61 (52,69)	61 (52,70)	61 (53,69)
Sex	Female	700 (35.7%)	543 (35.1%)	157 (37.9%)
	Male	1261 (64.3%)	1004 (64.9%)	257 (39.4%)
Socioeconomic status quintile (SIMD)	1 - Most deprived	680 (36.4%)	526 (35.6%)	154 (39.4%)
	2	438 (23.4%)	356 (24.1%)	82 (21.0%)
	3	298 (15.9%)	235 (15.9%)	63 (16.1%)
	4	270 (14.4%)	217 (14.7%)	53 (13.6%)
	5 - Least deprived	183 (9.8%)	144 (9.7%)	39 (10.0%)
Ethnicity	White	468 (92.9%)	1311 (94.7%)	375 (95.9%)
	Other	36 (7.1%)	73 (5.3%)	16 (4.1%)
Comorbidity count	0	1095 (55.8%)	870 (56.2%)	225 (54.3%)
	1	414 (21.1%)	331 (21.4%)	83 (20.0%)
	2 plus	452 (23.0%)	346 (22.4%)	106 (25.6%)
Comorbidities	Cardiovascular	277 (14.1%)	222 (14.4%)	55 (13.3%)
	Respiratory	344 (17.5%)	268 (17.3%)	76 (18.4%)
	Diabetes Mellitus	294 (15.0%)	235 (15.2%)	59 (14.3%)
	Cancer	158 (8.1%)	113 (7.3%)	45 (10.9%)
	Other	302 (15.4%)	232 (15.0%)	70 (16.9%)
Emergency hospital admissions in previous year	0	1357 (69.2%)	1060 (68.5%)	297 (71.7%)
	1	438 (22.3%)	346 (22.4%)	92 (22.2%)
	2 plus	166 (8.5%)	141 (9.1%)	25 (6.0%)
Clinical frailty score (CFS)	Non-frail	1114 (56.8%)	860 (55.6%)	254 (61.4%)
	Vulnerable	328 (16.7%)	248 (16.0%)	80 (19.3%)
	Frail	258 (13.2%)	204 (13.2%)	54 (13.0%)
	Not known	261 (13.3%)	235 (15.2%)	26 (6.3%)

Time from hospital admission to critical care admission (days) Median (IQR)	1 (0,2)	1 (0,2)	0 (0,2)
P:F ratio			
Available, n (%)	481 (24.5%)	394 (25.5%)	87 (21.0%)
Median (IQR)	11.4 (9.1,15)	11.3 (9,14.8)	12 (9.6,15.1)
>13.3kPa, n (%)	176 (36.6%)	143 (36.3%)	33 (37.9%)
≤13.3kPa, n (%)	305 (63.4%)	251 (63.7%)	54 (62.1%)

CPAP indicates first set of consecutive days of CPAP prior to invasive ventilation, death or critical care discharge. 92 records have an unknown SIMD quintile. 186 records have unknown ethnicity. Percentages for organ support, advanced respiratory support, non-invasive ventilation, cardiovascular support and renal replacement therapy are based on complete recording of this data corresponding to admission date - 0 record(s) are currently missing.*PF ratios are only available for patients admitted to Level 3 areas on the first day of their Critical Care stay and percentages given for those with data available.

Supplementary Table 4: Factors associated with hospital mortality following invasive mechanical ventilation (individual comorbidities), protracted CPAP defined as ≥7 days

	Univariable model		Multivariable model	
	OR (95% CI)	p-value	OR (95% CI)	p-value
CPAP ≥7 days prior to IMV	2.09 (1.16,3.76)	0.015	1.56 (0.8,3.06)	0.194
Age	1.06 (1.04,1.08)	<0.001	1.07 (1.05,1.09)	<0.001
Male sex	1.59 (1.07,2.38)	0.022	1.39 (0.9,2.17)	0.140
SIMD (ref=5 - Least deprived)				
4	1.05 (0.5,2.23)	0.897	0.92 (0.4,2.09)	0.841
3	1.01 (0.5,2.04)	0.986	0.86 (0.39,1.88)	0.706
2	1.01 (0.51,2.02)	0.970	1.02 (0.48,2.18)	0.950
1 - Most deprived	0.82 (0.43,1.57)	0.545	0.9 (0.44,1.85)	0.778
Ethnicity (ref=White)				
Other	0.65 (0.33,1.29)	0.218	1.07 (0.45,2.53)	0.874
Comorbidities (ref=none)				
Single comorbidity	0.98 (0.62,1.53)	0.914	0.97 (0.58,1.63)	0.906
Multiple comorbidities	1.47 (0.88,2.45)	0.142	1.32 (0.71,2.46)	0.376
Prior emergency admission	0.89 (0.59,1.34)	0.569	0.76 (0.47,1.23)	0.258
Frailty (ref=Non-frail)				
Vulnerable or Frail	0.98 (0.63,1.52)	0.925	0.79 (0.48,1.29)	0.342
Natural Spline Admission Date 1	2.22 (1,4.93)	0.051	2.33 (0.97,5.6)	0.060
2	0.58 (0.12,2.8)	0.493	1 (0.17,5.77)	1.000
3	1.5 (0.38,5.9)	0.558	2.33 (0.48,11.34)	0.290
4	0.88 (0.13,6.21)	0.899	1.26 (0.15,10.86)	0.831
5	7.52 (2.11,26.72)	0.002	15.16 (3.56,64.47)	<0.001
PF ratio (ref=unavailable)				
>13.3kPa	1.09 (0.59,2.02)	0.790	1.15 (0.55,2.4)	0.715
<=13.3kPa	0.99 (0.65,1.49)	0.944	0.85 (0.53,1.37)	0.502

Logistic regression models showing odds ratios of various factors associated with Ultimate hospital mortality following IMV. Number of Observations = 540. Multiple imputation has been used to supplement missing data for Ultimate Hospital Mortality (n=32 (5.9 %)), SIMD (n=24 (4.4 %)), Frailty (n=77 (14.3 %)) and Ethnicity (n=40 (7.4 %). Admission date was assessed using a Natural Spline with 5 degrees of freedom

Supplementary Table 5: Factors associated with hospital mortality following invasive mechanical ventilation (Prior CPAP duration linear variable)

	Univariable OR (95% CI)	p-value	Multivariable OR (95% CI)	p-value
CPAP/HFNO days (prior to IMV)*	1.10 (1.03,1.18)	0.006	1.05 (0.97,1.13)	0.251
Age	1.06 (1.04,1.08)	<0.001	1.07 (1.05,1.09)	<0.001
Male sex	1.59 (1.07,2.38)	0.022	1.38 (0.89,2.15)	0.151
SIMD (ref=5 - Least deprived)				
4	1.05 (0.5,2.23)	0.897	0.92 (0.41,2.09)	0.847
3	1.01 (0.5,2.04)	0.986	0.86 (0.39,1.88)	0.704
2	1.01 (0.51,2.02)	0.970	1.03 (0.48,2.19)	0.940
1 - Most deprived	0.82 (0.43,1.57)	0.545	0.91 (0.44,1.87)	0.797
Ethnicity (ref=white) Other	0.65 (0.33,1.29)	0.218	1.09 (0.47,2.55)	0.839
Comorbidities (ref=none)				
Single comorbidity	0.98 (0.62,1.53)	0.914	0.96 (0.58,1.62)	0.889
Multiple comorbidities	1.47 (0.88,2.45)	0.142	1.33 (0.71,2.46)	0.369
Prior emergency admission	0.89 (0.59,1.34)	0.569	0.77 (0.48,1.24)	0.281
Frailty (ref=Non-frail) Vulnerable/Frail	0.98 (0.63,1.52)	0.925	0.78 (0.48,1.28)	0.323
Natural Spline Admission Date 1	2.22 (1,4.93)	0.051	2.29 (0.95,5.53)	0.064
2	0.58 (0.12,2.8)	0.493	1.03 (0.18,5.94)	0.976
3	1.5 (0.38,5.9)	0.558	2.2 (0.46,10.57)	0.319
4	0.88 (0.13,6.21)	0.899	1.25 (0.14,10.78)	0.839
5	7.52 (2.11,26.72)	0.002	15.31 (3.6,65.21)	<0.001
PF ratio (ref=unavailable)				
>13.3kPa	1.09 (0.59,2.02)	0.790	1.16 (0.55,2.42)	0.693
<=13.3kPa	0.99 (0.65,1.49)	0.944	0.87 (0.54,1.41)	0.563

Logistic regression models showing odds ratios of various factors associated with Ultimate hospital mortality following IMV. Number of Observations = 540. Multiple imputation has been used to supplement missing data for Ultimate Hospital Mortality (n=32 (5.9 %)), SIMD (n=24 (4.4 %)), Frailty (n=77 (14.3 %)) and Ethnicity (n=40 (7.4 %). Admission date was assessed using a Natural Spline with 5 degrees of freedom. *Duration of CPAP prior to IMV in days.

Supplementary Table 6: Characteristics of patients that received CPAP restricted to non-frail patients.

		All	CPAP <5 days	CPAP >=5 days
Number of patients	n	1114	659	455
Age on admission (years)	Median (IQR)	59 (50,68)	59 (49.5,67)	60 (51,68)
Sex	Female	369 (33.1%)	232 (35.2%)	137 (30.1%)
	Male	745 (66.9%)	427 (64.8%)	318 (69.9%)
Socioeconomic status quintile (SIMD)	1 - Most deprived	374 (35.6%)	228 (36.1%)	146 (34.7%)
	2	241 (22.9%)	143 (22.7%)	98 (23.3%)
	3	167 (15.9%)	99 (15.7%)	68 (16.2%)
	4	160 (15.2%)	102 (16.2%)	58 (13.8%)
	5 - Least deprived	110 (10.5%)	59 (9.4%)	51 (12.1%)
Ethnicity	White	1053 (95.0%)	622 (94.5%)	431 (95.8%)
	Black/Caribbean/ African/Other	20 (1.8%)	15 (2.3%)	5 (1.1%)
	Asian	35 (3.2%)	21 (3.2%)	14 (3.1%)
Previous health status				
Comorbidity count	0	721 (64.7%)	433 (65.7%)	288 (63.3%)
	1	209 (18.8%)	127 (19.3%)	82 (18.0%)
	2 plus	184 (16.5%)	99 (15.0%)	85 (18.7%)
Comorbidities	Cardiovascular disease	120 (10.8%)	69 (10.5%)	51 (11.2%)
	Respiratory disease	127 (11.4%)	68 (10.3%)	59 (13.0%)
	Diabetes Mellitus	128 (11.5%)	80 (12.1%)	48 (10.5%)
	Cancer	74 (6.6%)	38 (5.8%)	36 (7.9%)
	Other	116 (10.4%)	61 (9.3%)	55 (12.1%)
Emergency hospital admissions in previous year	0	845 (75.9%)	500 (75.9%)	345 (75.8%)
	1	223 (20.0%)	130 (19.7%)	93 (20.4%)
	2 plus	46 (4.1%)	29 (4.4%)	17 (3.7%)
Clinical frailty score (CFS)	Non-frail	1114 (100.0%)	659 (100.0%)	455 (100.0%)
Illness severity and organ support				
Time from hospital admission to ICU admission (days)	Median (IQR)	0 (0,2)	0 (0,2)	0 (0,2)
Number of organ systems supported on ICU admission	1	1093 (98.1%)	645 (97.9%)	448 (98.5%)
	2	21 (1.9%)	14 (2.1%)	7 (1.5%)

		All	CPAP <5 days	CPAP >=5 days
Non-invasive respiratory support on admission	n (%)	1114 (100.0%)	659 (100.0%)	455 (100.0%)
Cardiovascular support on admission	n (%)	18 (1.6%)	13 (2.0%)	5 (1.1%)
Renal replacement therapy on admission	n (%)	3 (0.3%)	1 (0.2%)	2 (0.4%)
PF ratio	Median (IQR)	11 (8.9,14.2)	10.6 (8.8,14.1)	11.3 (9.1,14.8)
	PF ratio Unavailable	809 (72.6%)	461 (70.0%)	348 (76.5%)
	>13.3 - Not Severe	96 (8.6%)	61 (9.3%)	35 (7.7%)
	<=13.3 - Severe	209 (18.8%)	137 (20.8%)	72 (15.8%)

CPAP indicates first set of consecutive days of CPAP prior to invasive ventilation, death or critical care discharge. 62 records have an unknown SIMD quintile. 6 records have unknown ethnicity. Percentages for organ support, advanced respiratory support, non-invasive ventilation, cardiovascular support and renal replacement therapy are based on complete recording of this data corresponding to admission date - 0 record(s) are currently missing. *PF ratios are only available for patients admitted to Level 3 or Level 3/2 areas on the first day of their Critical Care stay.

Supplementary Table 7: Outcomes for patients that received CPAP restricted to non-frail patients.

		All	CPAP <5 days	CPAP >=5 days	p-value
Number of patients	n	1114	659	455	
Outcome					
Unit mortality	n (%)	325 (29.3%)	195 (29.7%)	130 (28.8%)	0.759
Hospital mortality	n (%)	355 (34.5%)	211 (34.9%)	144 (33.9%)	0.777
Required invasive mechanical ventilation	n (%)	360 (32.3%)	247 (37.5%)	113 (24.8%)	<0.001
CPAP failure - invasive mechanical ventilation or died prior to discharge	n (%)	479 (43.0%)	307 (46.6%)	172 (37.8%)	0.004
Outcome without IMV					
Unit mortality without IMV	n (%)	119 (15.8%)	60 (14.6%)	59 (17.3%)	0.595
Hospital Mortality without IMV	n (%)	142 (20.4%)	72 (19.4%)	70 (21.7%)	0.508
Outcome following IMV					
Unit mortality following IMV	n (%)	206 (57.9%)	135 (54.9%)	71 (64.5%)	0.040
Hospital Mortality following IMV	n (%)	213 (63.8%)	139 (59.9%)	74 (72.5%)	0.037
Length of stay (days)					
Critical Care length of stay	Median (IQR)	9 (5,16)	8 (4,16)	9 (6,15.5)	<0.001
Post-ICU hospital stay (for patients discharged alive from ICU)	Median (IQR)	6 (3,15)	6 (3,14)	6 (3,17)	0.877
Total Hospital stay	Median (IQR)	14 (9,24)	13 (8,23)	15 (11,26)	<0.001
Organ support during critical care stay					
HFNO	n (%)	596 (53.5%)	309 (46.9%)	287 (63.1%)	<0.001
Cardiovascular support	n (%)	376 (33.8%)	250 (37.9%)	126 (27.7%)	<0.001
Renal support	n (%)	86 (7.7%)	57 (8.6%)	29 (6.4%)	0.162
Duration of organ support (days)*					
Invasive Mechanical Ventilation	Median (IQR)	14 (8,24.2)	14 (8.5,23.5)	14 (8,27)	0.845
Cardiovascular support	Median (IQR)	7 (3,12)	7 (3,12)	6 (2.2,12)	0.875
Renal support	Median (IQR)	7 (3,13.8)	8 (3,15)	4 (3,11)	0.320

Continuous Positive Airway Pressure (CPAP), Invasive Mechanical Ventilation (IMV), High Flow Nasal Oxygen (HFNO). Mortality percentages are calculated for patients who have completed their unit or hospital stay. * indicates data for patients who required organ support.

Supplementary Table 8: Factors associated with hospital mortality following invasive mechanical ventilation restricted to non-frail patients.

	Univariable OR (95% CI)	p-value	Multivariable OR (95% CI)	p-value
CPAP >=5 days vs <5 days	1.74 (1.05,2.89)	0.033	1.32 (0.74,2.35)	0.340
Age	1.07 (1.05,1.1)	<0.001	1.08 (1.05,1.11)	<0.001
Male sex (ref=female)	1.37 (0.83,2.25)	0.218	1.07 (0.61,1.9)	0.807
SIMD (ref=5 - Least deprived)				
4	1.28 (0.53,3.08)	0.578	1 (0.38,2.67)	0.996
3	0.82 (0.34,1.95)	0.648	0.6 (0.22,1.63)	0.313
2	0.98 (0.42,2.29)	0.963	1.04 (0.4,2.66)	0.941
1 - Most deprived	0.72 (0.33,1.57)	0.402	0.76 (0.32,1.81)	0.535
Ethnicity - Other (ref=white)	0.85 (0.35,2.09)	0.729	1.58 (0.58,4.3)	0.366
Comorbidities (ref=none)				
1 comorbidity	1.08 (0.61,1.92)	0.782	1.12 (0.59,2.1)	0.732
2 or more comorbidities	1.93 (1.01,3.66)	0.045	1.82 (0.87,3.81)	0.113
Prior emergency admission	1.12 (0.66,1.9)	0.668	0.91 (0.49,1.7)	0.771
Natural Spline Admission Date - 1	3.76 (0.78,18.03)	0.098	5.46 (1.02,29.37)	0.048
Natural Spline Admission Date - 2	0.67 (0.04,10.61)	0.773	3.84 (0.18,80.28)	0.385
Natural Spline Admission Date - 3	2.13 (0.38,11.95)	0.389	3.73 (0.55,25.43)	0.178
Natural Spline Admission Date - 4	7.12 (0.13,398.92)	0.338	49.46 (0.67,3660.59)	0.076
Natural Spline Admission Date - 5	2.53 (0.58,11.02)	0.210	4.86 (0.95,24.94)	0.058

Logistic regression models showing odds ratios of various factors associated with Ultimate hospital mortality following IMV. Number of Observations = 356. Multiple imputation has been used to supplement missing data for Ultimate Hospital Mortality (n=22 (6.2 %)), SIMD (n=15 (4.2 %)) and Ethnicity (n=1 (0.3 %)). Admission date was assessed using a Natural Spline with 5 degrees of freedom.

Critical care audit leads were contacted in each of the 19 hospital providing continuing critical care to patients with COVID-19 during the study period. Units in 10 of the 19 hospitals provided almost all non-invasive respiratory support in critical care areas rather than ward areas. All of these units contributed data to the SICSAG audit. Analyses presented in Supplementary Table 9 to 11 are restricted to patients admitted to these 10 units.

		All	CPAP <5 days	CPAP >=5 days
Number of patients	n	1194	747	447
Age on admission (years)	Median (IQR)	62 (53,70)	62 (53,71)	62 (52.5,70)
Sex	Female	429 (35.9%)	279 (37.3%)	150 (33.6%)
	Male	765 (64.1%)	468 (62.7%)	297 (66.4%)
Socioeconomic status quintile (SIMD)	1 - Most deprived	353 (31.0%)	218 (30.5%)	135 (31.9%)
	2	280 (24.6%)	178 (24.9%)	102 (24.1%)
	3	198 (17.4%)	122 (17.1%)	76 (18.0%)
	4	184 (16.2%)	124 (17.4%)	60 (14.2%)
	5 - Least deprived	122 (10.7%)	72 (10.1%)	50 (11.8%)
Ethnicity	White	1062 (97.0%)	661 (96.6%)	401 (97.6%)
	Black/Caribbean/African/Other	12 (1.1%)	8 (1,1%)	4 (0.9%)
	Asian	21 (1.9%)	15 (2.2%)	6 (1.5%)
Previous health status				
Comorbidity count	0	661 (55.4%)	411 (55.0%)	250 (55.9%)
	1	238 (19.9%)	156 (20.9%)	82 (18.3%)
	2 plus	295 (24.7%)	180 (24.1%)	115 (25.7%)
Comorbidities	Cardiovascular disease	178 (14.9%)	108 (14.5%)	70 (15.7%)
	Respiratory disease	218 (18.3%)	134 (17.9%)	84 (18.8%)
	Diabetes Mellitus	194 (16.2%)	132 (17.7%)	62 (13.9%)
	Cancer	105 (8.8%)	60 (8.0%)	45 (10.1%)
	Other	180 (15.1%)	116 (15.5%)	64 (14.3%)
Emergency hospital admissions in previous year	0	812 (68.0%)	491 (65.7%)	321 (71.8%)
	1	268 (22.4%)	170 (22.8%)	98 (21.9%)
	2 plus	114 (9.5%)	86 (11.5%)	28 (6.3%)
Clinical frailty score (CFS)	Non-frail	655 (54.9%)	380 (50.9%)	275 (61.5%)
	Vulnerable	195 (16.3%)	125 (16.7%)	70 (15.7%)

		All	CPAP <5 days	CPAP >=5 days
	Frail	181 (15.2%)	121 (16.2%)	60 (13.4%)
	Not known	163 (13.7%)	121 (16.2%)	42 (9.4%)
Illness severity and organ support				
Time from hospital admission to ICU admission (days)	Median (IQR)	1 (0,2)	1 (0,2)	1 (0,2)
Number of organ systems supported on ICU admission	1	1165 (97.6%)	727 (97.3%)	438 (98.0%)
	2	29 (2.4%)	20 (2.7%)	9 (2.0%)
Non-invasive respiratory support on admission	n (%)	1194 (100.0%)	747 (100.0%)	447 (100.0%)
Cardiovascular support on admission	n (%)	23 (1.9%)	17 (2.3%)	6 (1.3%)
Renal replacement therapy on admission	n (%)	6 (0.5%)	3 (0.4%)	3 (0.7%)
PF ratio	Median (IQR)	11.5 (9.3,15.2)	11.3 (9.3,15.2)	12 (9.4,15.3)
	PF ratio Unavailable	855 (71.6%)	516 (69.1%)	339 (75.8%)
	>13.3 - Not Severe	127 (10.6%)	88 (11.8%)	39 (8.7%)
	<=13.3 - Severe	212 (17.8%)	143 (19.1%)	69 (15.4%)

Note: CPAP indicates first set of consecutive days of CPAP prior to invasive ventilation, death or critical care discharge. 57 records have an unknown SIMD quintile. 99 records have unknown ethnicity. PF ratios are only available for patients admitted to Level 3 or Level 2/3 areas on the first day of their Critical Care stay.

Supplementary Table 10: Outcomes for patients that received CPAP restricted to patients in hospitals in which provision of non-invasive respiratory was limited to critical care units.
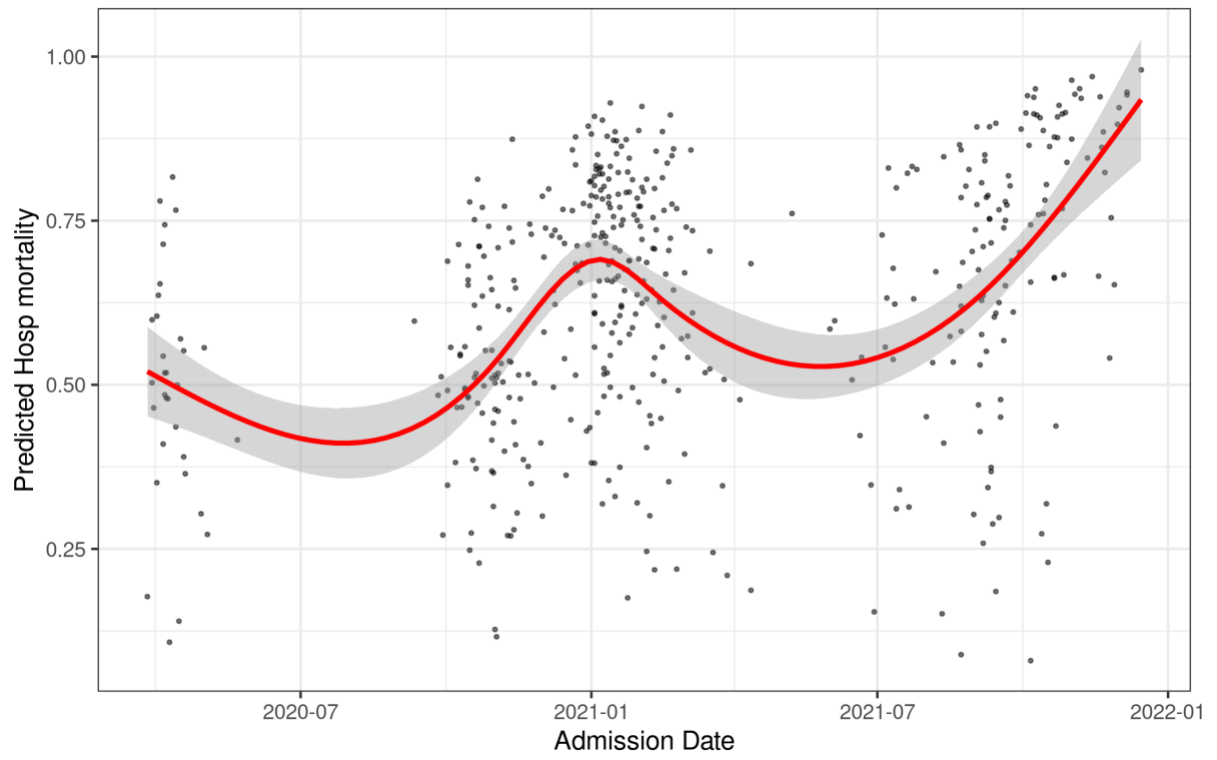
		All	CPAP <5 days	CPAP >=5 days	p-value
Number of patients	n	1194	747	447	
Outcome					
Unit mortality	n (%)	416 (35.0%)	264 (35.4%)	152 (34.4%)	0.727
Hospital mortality	n (%)	485 (43.6%)	315 (45.0%)	170 (41.3%)	0.250
Required invasive mechanical ventilation	n (%)	333 (27.9%)	235 (31.5%)	98 (21.9%)	<0.001
CPAP failure - invasive mechanical ventilation or died prior to discharge	n (%)	550 (46.1%)	367 (49.1%)	183 (40.9%)	0.006
Outcome without IMV					
Unit mortality without IMV	n (%)	217 (25.3%)	132 (25.8%)	85 (24.5%)	0.210
Hospital Mortality without IMV	n (%)	283 (35.5%)	181 (37.9%)	102 (31.8%)	0.087
Outcome following IMV					
Unit mortality following IMV	n (%)	199 (60.5%)	132 (56.4%)	67 (70.5%)	0.008
Hospital Mortality following IMV	n (%)	202 (64.3%)	134 (60.1%)	68 (74.7%)	0.020
Length of stay (days)					
Critical Care length of stay	Median (IQR)	8 (4,14)	6 (3,13)	9 (7,15)	<0.001
Post-critical care hospital stay (for patients discharged alive from ICU)	Median (IQR)	7 (3,15)	7 (3,14)	7 (3,17)	0.246
Total hospital length of stay	Median (IQR)	14 (9,24)	13 (7,22)	16 (11,26)	<0.001
Organ support during critical care stay					
HFNO	n (%)	660 (55.3%)	331 (44.3%)	329 (73.6%)	<0.001
Cardiovascular support	n (%)	376 (31.5%)	251 (33.6%)	125 (28.0%)	0.042
Renal support	n (%)	94 (7.9%)	65 (8.7%)	29 (6.5%)	0.169
Duration of organ support (days)*					
Advanced respiratory support	Median (IQR)	13 (8,24)	14 (8,24)	13 (7.2,22.8)	0.717
Cardiovascular support	Median (IQR)	6 (2,11)	6 (2,11)	5 (2,10)	0.203
Renal support	Median (IQR)	6 (3,13)	7 (3,14)	4 (3,13)	0.721

Continuous Positive Airway Pressure (CPAP), Invasive Mechanical Ventilation (IMV), High Flow Nasal Oxygen (HFNO). Mortality percentages are calculated for patients who have completed their unit or hospital stay. * indicates data for patients who required organ support.

Supplementary Table 11: Factors associated with hospital mortality following invasive mechanical ventilation restricted to patients in hospitals in which provision of non-invasive respiratory was limited to critical care units.

	Univariable OR (95% CI)	p-value	Multivariable OR (95% CI)	p-value
CPAP >=5 days vs <5 days	1.95 (1.13,3.34)	0.016	1.68 (0.88,3.2)	0.117
Age	1.06 (1.04,1.09)	<0.001	1.09 (1.06,1.12)	<0.001
Male sex (ref=female)	2.02 (1.22,3.35)	0.006	2.14 (1.19,3.85)	0.012
SIMD (ref=5 - Least deprived)				
4	1.49 (0.6,3.68)	0.388	1.33 (0.48,3.72)	0.585
3	1.01 (0.4,2.52)	0.987	0.79 (0.28,2.28)	0.666
2	1.28 (0.56,2.93)	0.550	1.42 (0.56,3.63)	0.463
1 - Most deprived	1.78 (0.77,4.11)	0.174	2.4 (0.92,6.26)	0.075
Ethnicity - Other (ref=white)	0.64 (0.22,1.82)	0.397	0.91 (0.27,3.05)	0.881
Comorbidities (ref=none)				
1 comorbidity	1.08 (0.6,1.94)	0.790	0.98 (0.49,1.95)	0.953
2 or more comorbidities	1.18 (0.61,2.27)	0.627	1.00 (0.43,2.34)	0.999
Prior emergency admission	0.89 (0.53,1.47)	0.638	0.70 (0.37,1.3)	0.256
Vulnerable/Frail (ref=non-frail)	0.97 (0.53,1.76)	0.916	0.66 (0.32,1.35)	0.251
Natural Spline Admission Date - 1	1.54 (0.57,4.14)	0.396	1.78 (0.58,5.46)	0.312
Natural Spline Admission Date - 2	0.52 (0.07,3.94)	0.527	1.46 (0.15,14.56)	0.749
Natural Spline Admission Date - 3	1.38 (0.23,8.11)	0.723	2.21 (0.32,15.19)	0.419
Natural Spline Admission Date - 4	1.27 (0.1,16.57)	0.855	2.24 (0.13,38.32)	0.576
Natural Spline Admission Date - 5	13.24 (2.16,81.3)	0.006	34.97 (4.62,264.86)	0.001

Logistic regression models showing odds ratios of various factors associated with Ultimate hospital mortality following IMV. Number of Observations = 329. Multiple imputation has been used to supplement missing data for Ultimate Hospital Mortality (n=15 (4.6 %)), SIMD (n=12 (3.6 %)), Frailty (n=55 (16.7 %)) and Ethnicity (n=23 (7 %)). Admission date was assessed using a Natural Spline with 5 degrees of freedom.

Admission date and predicted mortality

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┌─────────────────────────────────────────────┐
│  Admitted to critical care with COVID-19 between │
│        01/03/2020 and 25/12/2020              │
│              4829 patients                    │
└─────────────────────────────────────────────┘
                      │
                      ▼
┌─────────────────────────────────────────────┐
│         CPAP for respiratory support          │
│              1961 patients                    │
└─────────────────────────────────────────────┘
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	CPAP/HFNO duration <5 consecutive days 1228 patients	CPAP/HFNO duration ≥5 consecutive days 733 patients

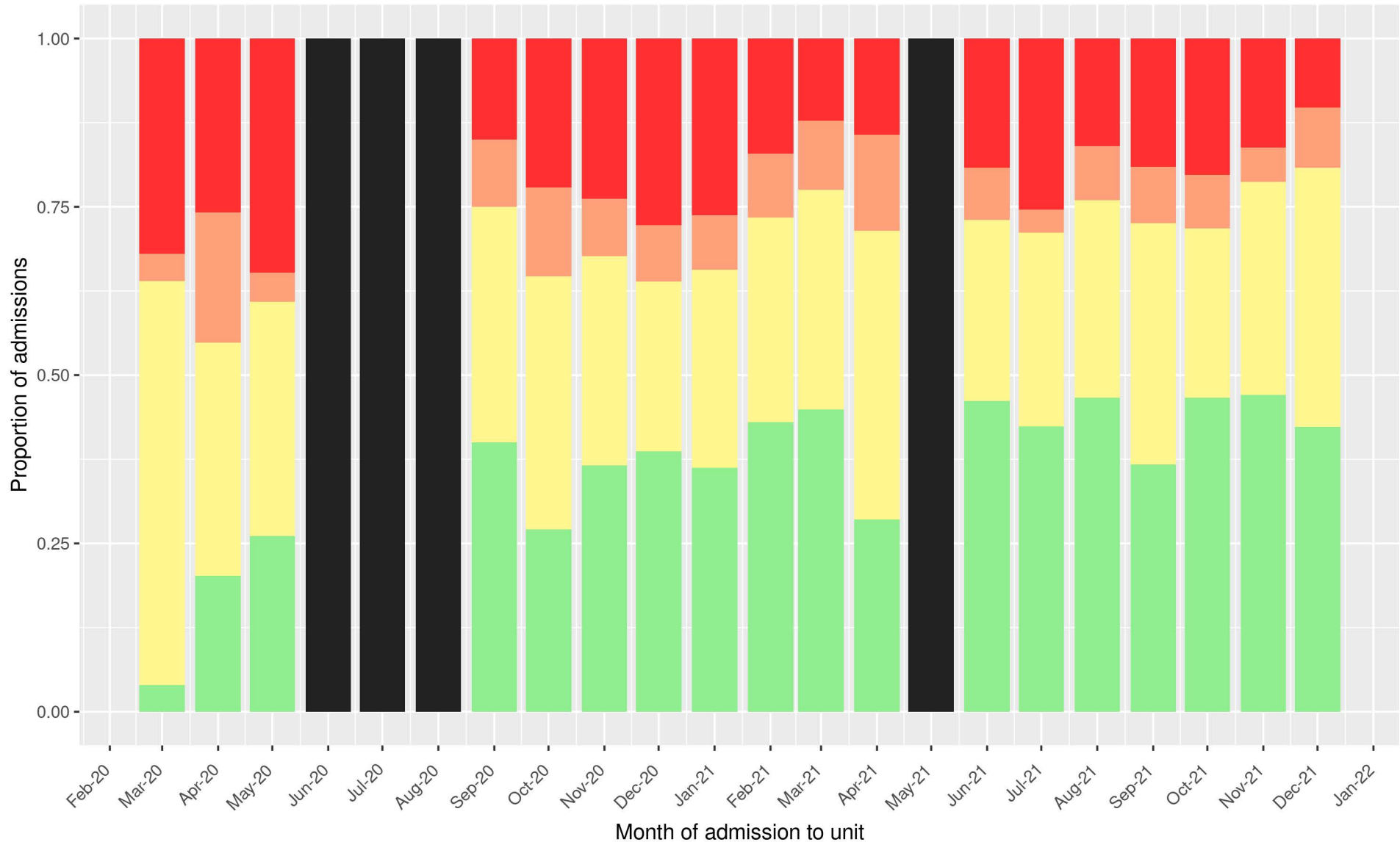| Improved 627 patients	Invasive mechanical ventilation 389 patients	Died without IMV 212 patients	Improved 443 patients	Invasive mechanical ventilation 155 patients	Died without IMV 135 patients

| Died prior to hospital discharge 64 patients | Died prior to hospital discharge 215 patients | | Died prior to hospital discharge 25 patients | Died prior to hospital discharge 105 patients | |

Note: In total there are 2 admissions for which outcome is not known (currently inpatients who have not been intubated).