

**Physical Rehabilitation in Critically Ill Children: A Multicenter Point Prevalence  
Study in the United States**

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### **SDC 1. Additional Details for Statistical Analysis**

We performed regression diagnostics including checks for collinearity of covariates and linear association of log-odds of outcomes with continuous variables. PICU LOS was log-transformed because it had a skewed distribution. After log-transformation, this variable had a U-shaped association with the study outcomes; thus, linear splines were included in the model at 100 days for therapist-provided mobility and at 10 days for out-of-bed mobility. We explored for statistical interaction of age with all covariates on the outcome of out-of-bed mobility. We included interaction terms if significant in the multivariable regression model at  $P < 0.05$ , and presented adjusted odds ratios (aORs) within two age strata:  $< 3$  or  $\geq 3$  years old. Missing data represented  $< 2\%$  for all variables in our primary analyses; therefore, we performed complete case analysis.

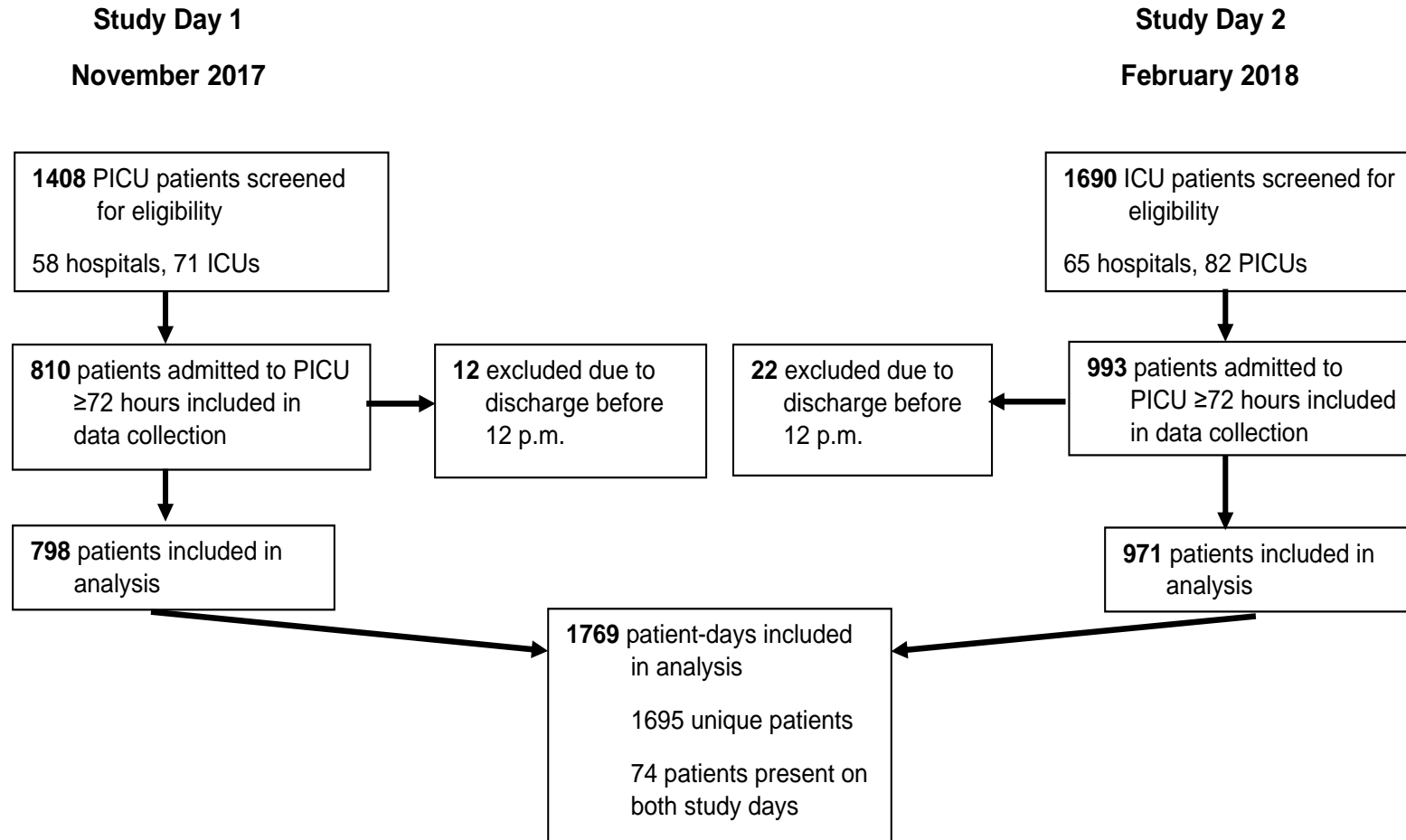
## SDC 2. Map of Participating PICU sites



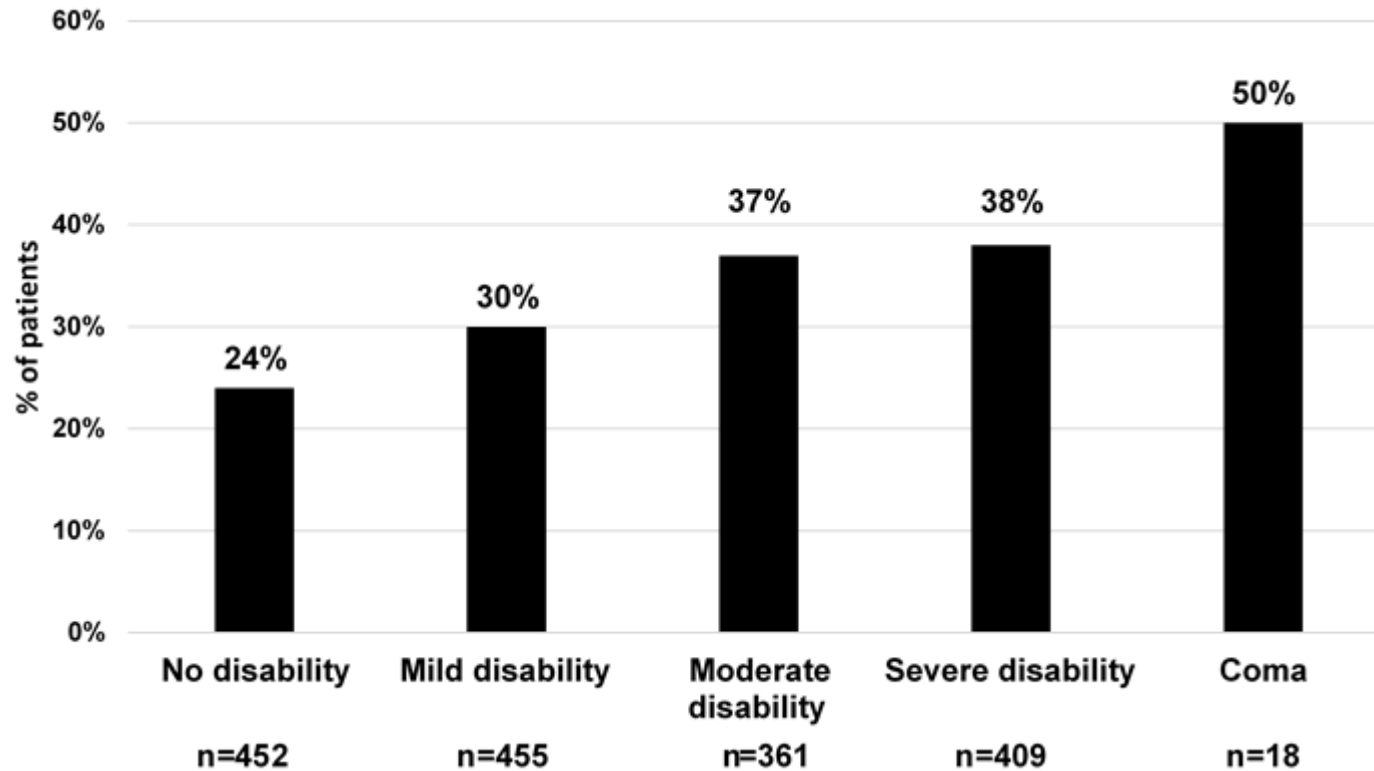
Each marker represents one hospital. N=49 hospitals with 1 participating ICU; N=15 hospitals with 2 participating ICUs; N=1 hospital with 3 participating ICUs

<b>SDC 3. Demographics of the 82 Participating PICUs</b>		
<b>Characteristic</b>	<b>Value N=82</b>	<b># of patients (%) N=1769</b>
Number of PICU beds, median (IQR)	24 (16 - 30)	na
Academic teaching hospital, n (%)	75 (92)	1653 (93)
Free-standing children's hospital, n (%)	45 (55)	1212 (69)
Type of PICU, n (%)		
Medical-surgical with cardiac	36 (44)	777 (44)
Medical-surgical without cardiac	33 (40)	678 (38)
Cardiac only	13 (16)	374 (18)
All single-patient rooms, n (%)	58 (71)	1207 (68)
Early mobility protocol, n (%)	22 (27)	468 (27)
% dedicated FTE for PICU (IQR)		
Physical therapy	0.3 (0-0.7)	na
Occupational therapy	0.2 (0-0.5)	na

IQR, Interquartile range; PICU, pediatric intensive care unit; FTE, full-time equivalent

**SDC 4. Study Flow Chart**

**SDC 5. Proportion of patients with PT or OT Consultation request by PICU Day 3, by baseline Pediatric Cerebral Performance Category**



SDC 6: Patient Baseline Characteristics, separated by PT and OT-provided mobility

Demographics	All patient-days n=1769	PT-provided mobility n=448	No PT-provided mobility n=1,321	P value <sup>a</sup>	OT-provided mobility n=401	No OT-provided mobility n=1,348	P value <sup>a</sup>
Age, n (%)							
0 – 2 yrs	1100 (62)	223 (50)	877 (66)	<0.001	231 (58)	869 (64)	0.17
3 – 6 yrs	196 (11)	57 (13)	139 (11)		44 (11)	152 (11)	
7 – 12 yrs	220 (12)	71 (16)	149 (11)		59 (15)	161 (12)	
13 – 17 yrs	195 (11)	73 (16)	122 (9)		50 (13)	145 (11)	
>18 yrs	58 (3)	24 (5)	34 (3)		17 (4)	41 (3)	
Female, n (%)	767 (43)	180 (40)	587 (44)	0.26	164 (41)	603 (44)	0.26
Ethnicity, n (%) <sup>b</sup>							
White	864 (49)	229 (51)	635 (48)	0.05	224 (56)	640 (47)	0.02
Black	397 (23)	102 (23)	295 (22)		78 (20)	319 (23)	
Hispanic	76 (4)	26 (6)	50 (4)		19 (5)	57 (4)	
Asian	295 (17)	68 (15)	227 (17)		58 (15)	237 (17)	
Other	130 (7)	22 (5)	108 (8)		22 (6)	108 (8)	
BMI, median (IQR) <sup>b</sup>	17 (15 – 20)	15 (15 – 21)	17 (15 – 20)	<0.001	17 (15 – 21)	18 (15 – 21)	0.23
PICU LOS, median (IQR)	12 (6 – 30)	18 (8 – 41)	11 (6 – 27)	<0.001	18 (8 – 41)	11 (6 – 27)	<0.001
Pre-admission function, n (%) <sup>c</sup>							
1- Good	455 (26)	101 (23)	354 (27)	<0.001	94 (23)	361 (27)	<0.001
2- Mild disability	472 (27)	127 (28)	345 (26)		122 (30)	350 (26)	
3- Moderate disability	380 (22)	113 (25)	267 (20)		109 (27)	271 (20)	
4- Severe disability	442 (25)	103 (23)	339 (26)		75 (19)	367 (27)	
5- Coma/vegetative state	20 (1)	4 (1)	16 (1)		1 (0)	19 (1)	
Ambulatory before admission, if age ≥3, n (%) <sup>a</sup>	424 (63)	176 (78)	248 (56)	<0.001	136 (80)	288 (58)	<0.001
Primary admission reason, n (%) <sup>b</sup>							
Surgical							
Cardiac	274 (16)	70 (16)	204 (15)		60 (15)	214 (16)	
Neurologic	85 (5)	34 (8)	51 (4)		26 (7)	59 (4)	
Orthopedic	8 (1)	4 (0)	4 (1)		2 (1)	6 (0)	
Other	101 (6)	26 (6)	75 (6)		20 (5)	81 (6)	

Medical				0.005			0.01
Respiratory	671 (38)	145 (32)	526 (40)		126 (31)	545 (40)	
Cardiac	282 (16)	70 (16)	212 (16)		71 (18)	211 (15)	
Hematology-oncology	40 (2)	14 (3)	26 (2)		14 (4)	26 (2)	
Infectious/inflammatory	104 (6)	27 (6)	77 (6)		23 (6)	81 (6)	
Neurologic	103 (6)	31 (7)	72 (5)		29 (7)	74 (5)	
Other	97 (5)	27 (6)	70 (5)		30 (8)	67 (5)	
Early mobility protocol <sup>d</sup>	468 (26)	134 (30)	334 (25)	0.06	132 (33)	336 (25)	0.001

Abbreviations: BMI, body mass index; IQR, interquartile range; LOS, length of stay; PT, physical therapy; PICU, pediatric intensive care unit

<sup>a</sup> Calculated using chi-squared test for categorical variables and Mann-Whitney U test for continuous variables.

<sup>b</sup> Missing data: ethnicity (n=7); body mass index (n=84); admission reason (n=6).

<sup>c</sup> Pediatric Cerebral Performance Category.

<sup>d</sup> Defined as unit-based guideline or policy for early mobility.



**SDC 7: Patient Clinical Characteristics on Study Day, separated by PT or OT-provided mobility**

Clinical Characteristic on Study Day	All N = 1769	PT- provided mobility N = 448	No PT- provided mobility N = 1,321	P-value <sup>a</sup>	OT- provided mobility N = 401	No OT- provided mobility N = 1,348	P-value <sup>a</sup>
Respiratory support, n (%) <sup>b</sup>							
No support	312 (18)	99 (22)	213 (16)	<0.001	86 (22)	226 (17)	<0.001
Nasal cannula or face mask	166 (9)	55 (12)	111 (8)		54 (14)	112 (8)	
HFNC or RAM cannula	209 (12)	53 (12)	156 (12)		47 (12)	162 (12)	
Tracheostomy collar	38 (2)	13 (3)	25 (2)		10 (3)	28 (2)	
Mechanical ventilation– noninvasive	167 (9)	39 (9)	128 (10)		43 (11)	124 (9)	
Mechanical ventilation– tracheostomy	260 (15)	78 (18)	182 (14)		65 (16)	195 (14)	
Mechanical ventilation– endotracheal	611 (35)	110 (25)	501 (38)		95 (24)	516 (39)	
FiO <sub>2</sub> , median (IQR) <sup>b,c</sup>	35 (28 – 50)	32 (25 – 45)	35 (28 – 50)	0.13	30 (25 – 45)	35 (30 – 50)	0.06
GCS, median (IQR) <sup>b</sup>	12 (9 – 15)	14 (9 – 15)	11 (9 – 15)	<0.001	14 (9 – 15)	11 (9 – 15)	0.08
≥1 sedative/analgesic infusion, n (%)	809 (46)	175 (39)	634 (48)	0.001	155 (39)	654 (48)	0.001
Delirium present, n (%)							
No	453 (26)	124 (28)	329 (25)	0.09	118 (30)	335 (25)	0.10
Yes	182 (10)	55 (12)	127 (10)		43 (11)	139 (10)	
Not available	1133 (64)	269 (60)	864 (65)		239 (60)	894 (65)	
Any vasoactive infusion, n (%) <sup>d</sup>	222 (13)	47 (11)	175 (13)	0.13	40 (10)	182 (13)	0.08
Any physical restraint, n (%)	249 (14)	52 (12)	197 (15)	0.08	48 (12)	201 (15)	0.05
Any central venous catheter, n (%)	1189 (67)	311 (69)	878 (67)	0.25	278 (69)	911 (67)	0.31
Arterial catheter, n (%)	483 (27)	107 (24)	376 (29)	0.06	79 (20)	404 (30)	<0.001
Hemodialysis catheter, n (%)	84 (5)	31 (7)	53 (4)	0.01	26 (7)	58 (4)	0.06
ECMO cannula, n (%)	39 (2)	10 (2)	29 (2)	0.96	7 (2)	32 (2)	0.48
Indwelling urinary catheter, n (%)	249 (14)	54 (12)	195 (15)	0.15	41 (10)	208 (15)	0.01
Surgical drain, n (%)	135 (8)	39 (9)	96 (7)	0.32	37 (9)	98 (7)	0.17
Chest tube, n (%)	194 (11)	52 (12)	142 (11)	0.62	34 (9)	160 (12)	0.07
Ventricular assist device, n (%)	16 (1)	5 (1)	11 (1)	0.58	5 (1)	11 (1)	0.41
Intracranial pressure monitor, n (%)	50 (3)	18 (4)	32 (2)	0.08	17 (4)	33 (2)	0.05
Presence of pressure ulcer(s)	125 (7)	34 (8)	91 (7)	0.62	25 (6)	100 (7)	0.46

<b>SDC 7, cont.</b>							
<b>Clinical Characteristic on Study Day</b>	<b>All N = 1769</b>	<b>PT- provided mobility N = 448</b>	<b>No PT- provided mobility N = 1,321</b>	<b>P-value<sup>a</sup></b>	<b>OT- provided mobility N = 401</b>	<b>No OT- provided mobility N = 1,348</b>	<b>P-value<sup>a</sup></b>
Nurse:patient ratio, n (%) <sup>b</sup>							
2:1 or 1:1	733 (42)	158 (36)	575 (44)	0.003	147 (37)	586 (43)	0.03
1:2 or 1:3	1023 (58)	285 (64)	738 (56)		251 (63)	772 (57)	
Family present at bedside	1315 (74)	353 (79)	962 (73)	0.01	328 (82)	987 (72)	<0.001

Abbreviations: ECMO, extracorporeal membrane oxygenation; FiO<sub>2</sub>, fractional inspired oxygen concentration; GCS, Glasgow Coma Scale; HFNC, high-flow nasal cannula; IQR, interquartile range; PT, physical therapy.

<sup>a</sup> Calculated using chi-squared test and Mann-Whitney U test, as appropriate.

<sup>b</sup>Missing data: respiratory support (n=6); FiO<sub>2</sub> (n=2); GCS (n=3); nurse:patient ratio (n=13).

<sup>c</sup>Among patient-days with all types of respiratory support above nasal cannula or face mask (n=1291).

<sup>d</sup>Excluding milrinone

**SDC 8. Multivariable Adjusted Odds Ratios for PT and/or OT-provided mobility (primary outcome), with separate analyses for PT and OT**

	Any therapist-provided mobility N=625		PT-provided mobility N=448		OT –provided mobility N=401	
Characteristic	Adjusted OR (95% CI) <sup>a</sup>	P-value	Adjusted OR (95% CI) <sup>a</sup>	P-value	Adjusted OR (95% CI) <sup>a</sup>	P-Value
Age Category						
0-2	1 (reference)		1 (reference)		1 (reference)	
3-6	1.42 (0.98-2.07)	0.06	1.94 (1.31-2.87)	0.001	1.37 (0.9-2.08)	0.15
7-12	1.91 (1.34-2.73)	<0.001	2.45 (1.69-3.56)	<0.001	1.79 (1.21-2.66)	0.004
13-17	2.10 (1.45-3.06)	<0.001	3.00 (2.06-4.43)	<0.001	1.60 (1.06-2.44)	0.03
>18	1.58 (0.83-2.98)	0.16	2.98 (1.57-5.67)	<0.001	1.33 (0.66-2.67)	0.43
PICU day						
PICU days before day 100, per 10-fold change	2.49 (1.85-3.45)	<0.001	2.09 (1.52-2.88)	<0.001	2.28 (1.64-3.18)	<0.001
PICU days after day 100, per 10 fold change	0.51 (0.12-1.2)	0.37	0.48 (0.11-2.23)	0.35	0.83 (0.18-3.92)	0.81
Surgical admission	1.21(0.93-1.58)	0.15	1.37 (1.04-1.8)	0.03	1.09 (0.81-1.45)	0.57
Female gender	0.76 (0.61-0.95)	0.018	0.80 (0.3-1.02)	0.08	0.89 (0.69-1.14)	0.35
Respiratory support						
None	1 (reference)		1 (reference)		1 (reference)	
Nasal Cannula/Face mask	1.46 (0.94-2.27)	0.09	1.23 (0.79-1.96)	0.35	1.61 (1.0-2.57)	0.05
HHFNC or RAM Cannula	1.09 (0.71-1.69)	0.69	1.05 (0.67-1.65)	0.83	1.17 (0.73-1.89)	0.51
Trach collar	1.67 (0.76-3.69)	0.2	1.36 (0.61-3.09)	0.45	1.38 (0.57-3.34)	0.47
Mech vent-noninvasive	1.12 (0.71-1.79)	0.61	0.76 (0.46-1.24)	0.27	1.33 (0.81-2.19)	0.27
Mech vent-tracheostomy	1.34 (0.86-2.09)	0.19	1.14 (0.72-1.81)	0.57	1.23 (0.75-1.99)	0.42
Mech vent-endotracheal tube	0.71 (0.47-1.08)	0.11	0.61 (0.39-0.96)	0.03	0.69 (0.43-1.1)	0.12
Baseline PCPC						
No disability	1 (reference)		1 (reference)		1 (reference)	
Mild disability	1.19 (0.89-1.65)	0.31	1.2 (0.84-1.7)	0.32	1.08 (0.75-1.56)	0.67
Moderate disability	1.38 (1.04-2.06)	0.03	1.33 (0.92-1.93)	0.13	1.13 (0.77-1.66)	0.53
Severe disability	0.74 (0.52-1.05)	0.09	0.91 (0.62-1.34)	0.646	0.54 (0.36-0.81)	0.003
Coma	0.32 (0.09-1.15)	0.08	0.57 (0.17-1.98)	0.38	0.12 (0.01-0.99)	0.05

<b>SDC 8. Therapist-provided mobility (cont.)</b>	<b>Any therapist-provided mobility</b>		<b>PT-provided mobility N=448</b>		<b>OT –provided mobility N=401</b>	
<b>Characteristic</b>	<b>Adjusted OR (95% CI)<sup>a</sup></b>	<b>P-value</b>	<b>Adjusted OR (95% CI)<sup>a</sup></b>	<b>P-value</b>	<b>Adjusted OR (95% CI)<sup>a</sup></b>	<b>P-Value</b>
Vasoactive infusion <sup>b</sup>	0.80 (0.55-1.20)	0.29	0.80 (0.53-1.24)	0.32	0.85 (0.54-1.34)	0.49
Benzodiazepine infusion	0.92 (0.64-1.3)	0.64	0.93 (0.63-1.38)	0.71	0.98 (0.65-1.48)	0.90
Opioid infusion	1.06 (0.76-1.48)	0.72	1.06 (0.74-1.52)	0.77	0.92 (0.63-1.34)	0.66
Nurse:patient ratio 1:2 or 1:3	1.32 (0.99-1.75)	0.06	1.32 (0.98-1.77)	0.07	1.10 (0.81-1.5)	0.53
Urinary bladder catheter	0.98 (0.67-1.43)	0.91	0.96 (0.64-1.44)	0.84	0.88 (0.57-1.37)	0.57
Arterial or Central Venous Catheter	1.22 (0.93-1.63)	0.15	1.28 (0.95-1.73)	0.11	1.34 (0.97-1.84)	0.07
Hemodialysis catheter	1.38 (0.81-2.33)	0.23	1.42 (0.83-2.43)	0.21	1.21 (0.68-2.14)	0.52
Intracranial pressure monitor	2.25 (1.15-4.39)	0.02	1.80 (0.91-3.57)	0.09	1.72 (0.84-3.52)	0.14
Family presence	1.43 (1.08-1.89)	0.01	1.15 (0.86-1.55)	0.35	1.43 (1.04-2.58)	0.03
Unit mobility guideline/protocol	1.58 (0.99-2.51)	0.05	1.31 (0.88-1.94)	0.18	1.64 (1.04-2.59)	0.03

<sup>a</sup>Multivariable model includes random effect for site and is adjusted for ethnicity and all characteristics listed

<sup>b</sup>Any vasoactive not including milrinone

Abbreviations: HHFNC: Heated high flow nasal cannula; RAM: RAM cannula; mech vent: mechanical ventilation; PCPC: pediatric cerebral performance category

**SDC 9. Univariate and Multivariable Adjusted Odds Ratios for Out-of-Bed Mobility**

Characteristic	Crude OR (95%CI) <sup>a</sup>	P-value	Adjusted OR (95% CI) <sup>b</sup>	P-value
Age				
<3 years	1 (reference)	-	1 (reference)	-
≥3 years	0.77 (0.63-0.95)	0.015	1.0 (0.56-1.8)	0.99
PICU day				
PICU days before day 10, per 10-fold, comparing 10 vs 1 days	0.37 (0.18-0.75)	0.006	0.52 (0.21-1.33)	0.17
PICU days after day 10, per 10-fold, comparing 100 vs 10 days	1.74 (1.8-2.34)	0.001	1.99 (1.3-3.0)	0.001
Respiratory support				
None	1 (reference)	-	1 (reference)	-
Nasal cannula/face mask	0.74 (0.48-1.15)	0.18	0.78 (0.47-1.3)	0.34
HHFNC or RAM cannula	0.64 (0.43-0.97)	0.03	0.60 (0.38-0.96)	0.03
Trach collar	0.45 (0.22-0.95)	0.035	0.42 (0.19-0.96)	0.04
Mech vent–noninvasive	0.48 (0.31-0.72)	0.001	0.53 (0.32-0.87)	0.01
Mech vent–tracheostomy	0.30 (0.20-0.43)	<0.001	0.36 (0.22-0.56)	<0.001
Mech vent–endotracheal tube	0.05 (0.04-0.08)	<0.001	0.13 (0.08-0.2)	<0.001
Baseline PCPC				
No disability	1 (reference)	-	1 (reference)	-
Mild disability	1.39 (1.05-1.84)	0.02	1.45 (1.0-2.1)	0.05
Moderate disability	1.22 (0.91-1.64)	0.19	1.08 (0.73-1.6)	0.70
Severe disability	0.73 (0.55-0.97)	0.03	0.59 (0.40-0.87)	0.007
Coma	0.39 (0.13-1.13)	0.08	0.37 (0.11-1.3)	0.11
Vasoactive infusion <sup>c</sup>	0.21 (0.159-0.30)	<0.001	0.81 (0.49-1.3)	0.39
Benzodiazepine infusion	0.20 (0.15-0.28)	<0.001	0.97 (0.58-1.63)	0.85
Opioid infusion	0.16 (0.12-0.20)	<0.001	0.42 (0.24-0.73)	<0.001
Nurse:patient ratio 1:2 or 1:3	4.57 (3.59-5.81)	<0.001	1.82 (1.20-2.80)	0.004
Indwelling urinary catheter	0.11 (0.07-0.17)	<0.001	0.28 (0.14-0.57)	<0.001
Arterial or central venous catheter	0.32 (0.26-0.41)	<0.001	0.58 (0.38-0.89)	0.006

<b>SDC 9. Out of Bed Mobility (cont.)</b>				
<b>Characteristic</b>	<b>Crude OR (95%CI)<sup>a</sup></b>	<b>P-value</b>	<b>aOR (95% CI)<sup>b</sup></b>	<b>P-value</b>
Chest tube	0.26 (0.18-0.38)	<0.001	0.49 (0.26-0.91)	0.01
Hemodialysis catheter	0.26 (0.15-0.47)	<0.001	0.30 (0.15-0.63)	0.001
Intracranial pressure monitor	0.79 (0.44-1.44)	0.44	0.56 (0.24-1.30)	0.18
Unit mobility guideline/protocol	1.60 (1.17-2.28)	0.003	1.73 (1.14-2.6)	0.01
Family presence <sup>d</sup>				
Age <3 years	3.93 (2.9-5.34)	<0.001	4.55 (3.13-6.6)	<0.001
Age ≥ 3 years	2.03 (1.35-3.06)	0.001	1.62 (0.98-2.7)	0.06
PT-OT involvement on study day <sup>e</sup>				
Age<3 years	1.92 (1.46-2.52)	<0.001	1.43 (1.0-2.0)	0.045
Age≥3 years	2.61 (1.87-3.65)	<0.001	3.1 (2.01-4.79)	<0.001

Abbreviations: aOR, adjusted odds ratio; HHFNC, heated high-flow nasal cannula; mech vent, mechanical ventilation; OR, odds ratio; PCPC, Pediatric Cerebral Performance Category; RAM, RAM cannula.

<sup>a</sup>Crude estimates include random effect for site and no adjustment for any covariate.

<sup>b</sup>Adjusted estimate includes random effect for site, in addition to adjustment for admission reason and ethnicity and all variables listed in the table.

<sup>c</sup>Any vasoactive infusion, excluding milrinone.

<sup>d</sup>Interaction term for family presence by age strata in crude model ( $P=0.005$ ) and adjusted model ( $P=0.001$ ).

<sup>e</sup>Interaction term for PT-OT involvement by age strata in crude model ( $P=0.16$ ) and adjusted model ( $P=0.005$ ).

<b>SDC 10. Frequency of Reported Barriers to Mobilization</b>	
<b>Barrier</b>	<b>No. (%)</b>
Medical contraindication*	154 (9)
Circulation/heart*	154 (9)
Too sedated*	147 (8)
Isolation precautions*	106 (6)
Pain*	91 (5)
No physician order*	89 (5)
Previously immobile*	74 (4)
Post-op restriction*	67 (4)
Patient not on unit*	52 (3)
Bleeding risk*	52 (3)
Mechanical ventilation	47 (3)
Acquired neuromuscular weakness*	45 (3)
Presence of medical device*	40 (2)
Contraindication from patient*	40 (2)
Extracorporeal membrane oxygenation*	35 (2)
Large catheter*	34 (2)
Unable to schedule session	31 (2)
Agitation	29 (2)
No nursing available*	26 (2)
No therapist available*	25 (1)
Delirium*	23 (1)
Terminal stage*	20 (1)
Chemical paralysis	20 (1)
Desaturates with activity	19 (1)
Contraindication from parent*	17 (1)
Intracranial pressure monitor	17 (1)
Critical airway	14 (1)
Bedrest orders	12 (1)
Lack of equipment*	11 (1)

\*Pre-specified option for survey item "If there were mobilization barriers, please select all the barriers to mobilization."