Supplemental digital content:

DYsphAgia in Mechanically ventilated Intensive Care unit patientS (*DYnAMICS*): a prospective observational trial

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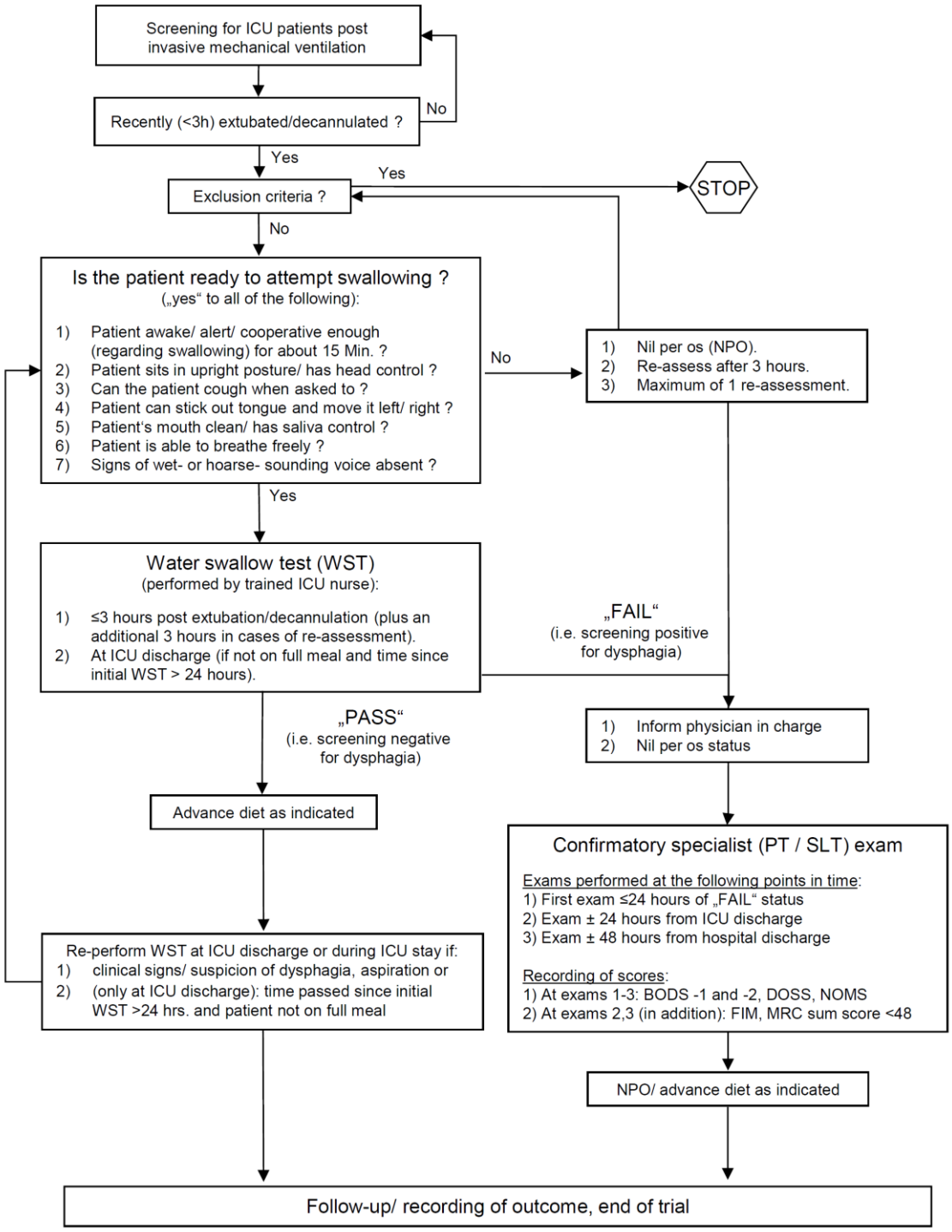
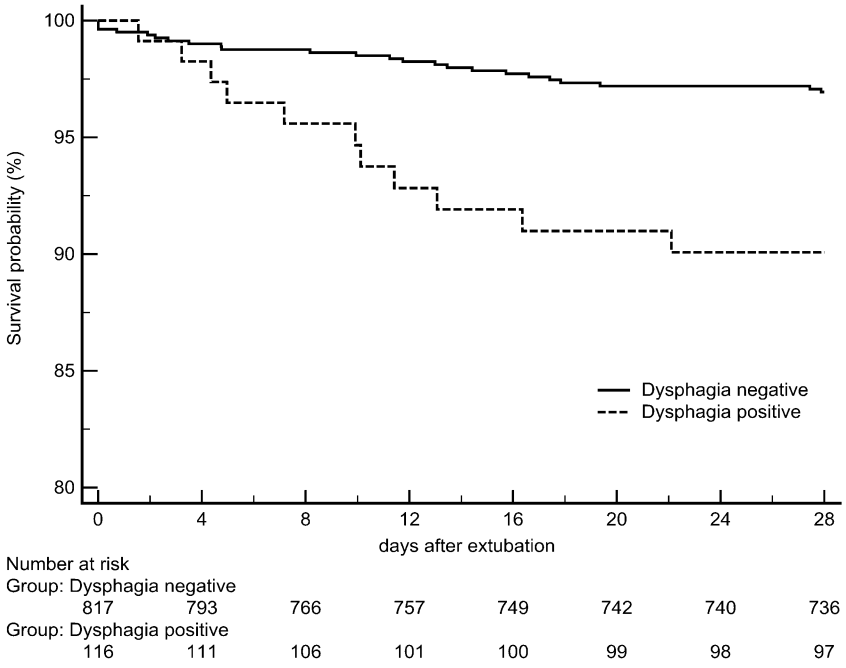
Fig. E1: Screening algorithm, confirmatory specialist examination, and follow up



BODS= Bogenhausen Dysphagia Score, DOSS=Dysphagia Outcome Severity Scale, FIM= functional independence measure, MRC= Medical Research Council, NOMS= National Outcomes Measurement System, NPO= nil per os, PT= Physiotherapist, SLT= speech language therapist.

Fig. E2: Survival estimates for (A) all-cause 28-day and (B) all-cause 90-day mortality in dysphagia screening positive/ negative patients (days after extubation)

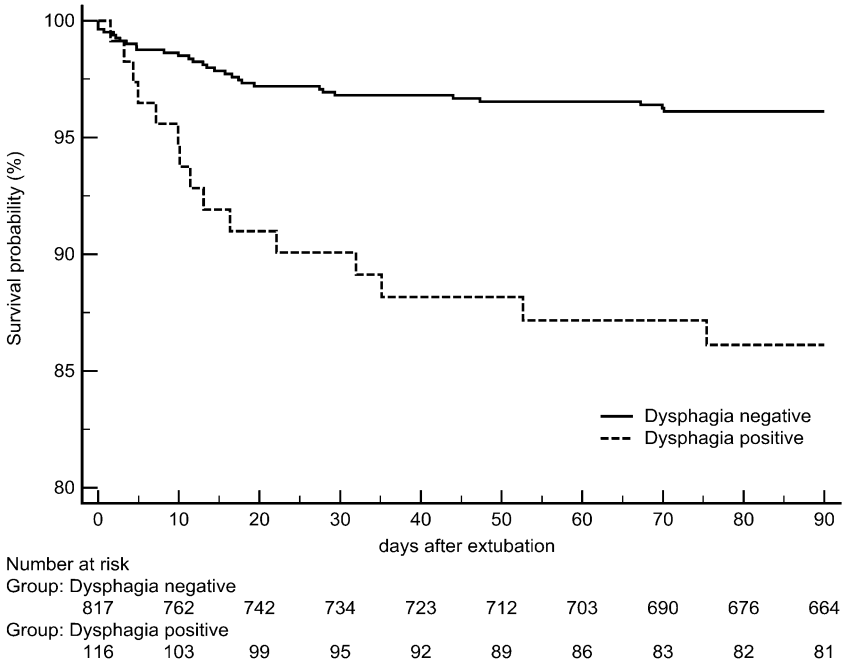
A)



Number at risk

Group: Dysphagia negative							
817	793	766	757	749	742	740	736
Group: Dysphagia positive							
116	111	106	101	100	99	98	97

B)



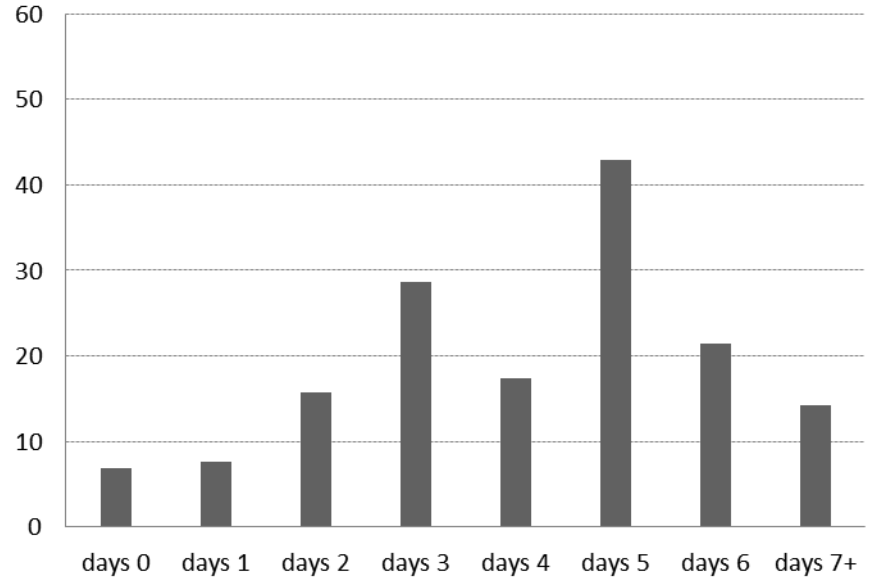
Number at risk

Group: Dysphagia negative									
817	762	742	734	723	712	703	690	676	664
Group: Dysphagia positive									
116	103	99	95	92	89	86	83	82	81

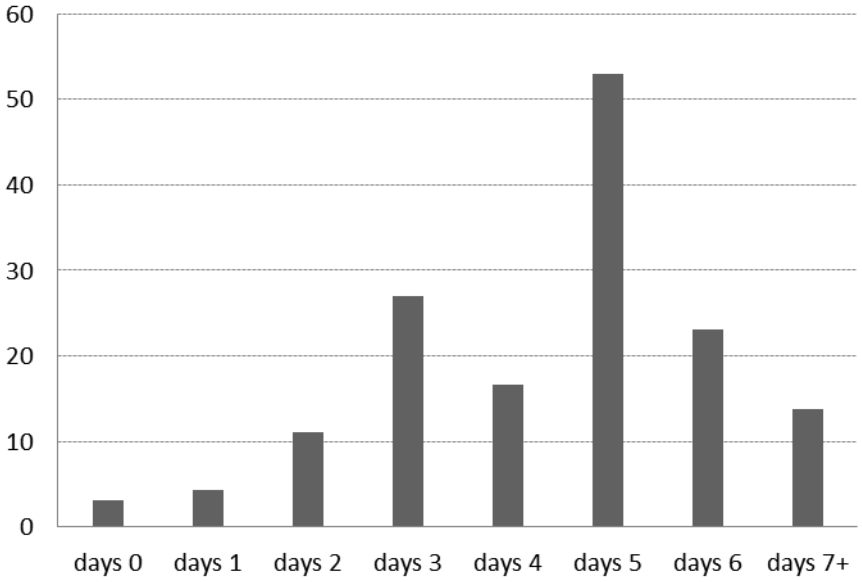
Kaplan Meier survival estimates. (A) 28-day mortality hazard ratio in dysphagia group: 3.34 (95%-CI: 1.21-9.26), p<0.001, X^2=12.4 and (B) 90-day mortality HR 3.73 (95%-CI: 1.51-9.21), p<0.001, X^2=20.0

Fig. E3: Incidence of dysphagia and length of mechanical ventilation

A)



B)



Incidence of dysphagia (given in percent) and total days on mechanical ventilation in the overall cohort (Fig. E 3A) and in the cohort of patients admitted for non-neurological reasons (Fig. E3B; defined by APACHE IV admission category).

Table E1: Evolution of dysphagia disease severity

		Initial exam on ICU (≤24 hrs. of screening)	**ICU discharge exam** (±24 hrs. of ICU discharge)			**Hospital discharge exam** (±48 hrs. of hosp. discharge)		
index (score)	**range**	**total cohort n=116**	total cohort n=110 (n=6 lost to FU)	**Dysphagia positive in ICU discharge BSE (n=96)**	Dysphagia negative in ICU discharge BSE (n=14)	total cohort n=90 (n=6 died)	**Dysphagia positive in hospital discharge BSE (n=58)**	Dysphagia negative in hospital discharge BSE (n=32)
BODS-1 score	1-8	**2.0 [1.0-3.0]**	1.0 [1.0-3.0]	**2.0 [1.0-3.0]**	1.0 [1.0-1.0]	1.0 [1.0-2.0]	**1.0 [1.0-2.0]**	1.0 [1.0-1.0]
BODS-2 score	1-8	**8.0 [5.0-8.0]**	7.0 [3.0-8.0]	**8.0 [5.0-8.0]**	1.0 [1.0-2.0]	2.0 [1.0-6.0]	**5.0 [2.0-8.0]**	1.0 [1.0-1.0]
BODS sum score	2-16	**9.0 [7.0-11.0]**	9.0 [4.0-10.0]	**9.0 [6.5-11.0]**	2.0 [2.0-3.0]	3.0 [2.0-8.0]	**6.0 [3.0-10.0]**	2.0 [2.0-2.0]
DOSS score	1-7	**1.0 [1.0-3.3]**	2.0 [1.0-5.0]	**1.0 [1.0-4.5]**	6.5 [6.0-7.0]	5.0 [2.0-7.0]	**2.0 [1.0-5.0]**	7.0 [7.0-7.0]
NOMS score	1-7	**1.0 [1.0-3.0]**	2.0 [1.0-5.0]	**1.0 [1.0-3.0]**	7.0 [6.0-7.0]	5.5 [3.0-7.0]	**3.0 [1.0-5.0]**	7.0 [7.0-7.0]
FIM score	18-126	**not performed**	24.0 [19.3-31.8]	**23.0 [18.8-29.3]**	36.5 [29.0-44.0]	55.0 [29.0-97.5]	**36.5 [26.0-66.0]**	84.0 [65.5-112.8]
MRC sum score (nr. of cases <48, %)	(yes/no)	**61/104 (58.7%) n=12 n.a.**	59/102 (57.8%) n=14 n.a.	**55/90 (61.1%) n=6 n.a.**	4/12 (33.3%) n=2 n.a.	34/87 (39.1%) n=3 data n.a.	**27/55 (49.1%) n=3 data n.a.**	7/31 (22.6%) n=1 data n.a.

Data are given for initial examination, ICU-, and hospital discharge (median/ interquartile range, or absolute numbers in %). Missing data: initial exam n=10, n=6 lost to follow up at ICU discharge exam, and n=6 died (hospital discharge exam). BODS= Bogenhausen Dysphagia Score, BSE= bedside swallow examination, DOSS= Dysphagia Outcome Severity Scale, FIM= functional independence measure, MRC= Medical Research council, n.a.= not available, NOMS= National Outcomes Measurement System.

Table E2: Univariate and multivariate regression models (90-day mortality)

	Single predictor model for 90-day mortality following ICU admission			Multivariate model for 90-day mortality following ICU admission		
Variable	**Hazard Ratio (95 % CI)**	**p-value**	**Wald**	**Hazard Ratio (95 % CI)**	**p-value**	**Wald**
Age (per 1 year increase)	1.02 (1.0-1.04)	0.10	2.7	1.009 (0.99-1.03)	0.45	0.58
Gender (female)	1.29 (0.69-2.40)	0.42	0.6	1.08 (0.58-2.02)	0.81	0.1
Weight (per 1 kg increase)	0.98 (0.96-0.99)	**0.04**	4.4	-	-	-
BMI (per 1 step increase)	0.96 (0.90-1.02)	0.21	1.6	-	-	-
APACHE II score (per 1 increase)	1.09 (1.05-1.14)	**<0.001**	20.9	1.08 (1.03-1.12)	**<0.001**	11.5
SAPS II score (per 1 increase)	1.03 (1.01-1.14)	**0.002**	10.1	-	-	-
Cumulative TISS-28 points (per 10 increase)	1.001 (1.0-1.001)	**0.006**	7.6	-	-	-
Admission category (emergency group)	3.78 (1.76-8.12)	**<0.001**	11.6	-	-	-
Dysphagia positivity on ICU (dysphagia group)	3.74 (2.01-6.95)	**<0.001**	17.4	2.95 (1.57-5.53)	**<0.001**	11.3
Days on invasive MV (per 1 increase)	1.04 (1.01-1.08)	**0.01**	6.17	1.04 (0.99-1.10)	0.09	3.0
Days on RRT (per 1 increase)	1.05 (0.98-1.13)	0.18	1.8	-	-	-
Days on vasopressors (per 1 increase)	0.95 (0.82-1.11)	0.53	0.4	-	-	-
Days on antimicrobials (per 1 increase)	0.89 (0.78-1.02)	0.09	2.9	-	-	-
Days on antibiotics (per 1 increase)	0.88 (0.77-1.01)	0.08	3.1	-	-	-

Hazard ratios for (co-)variates for ICU patients after invasive mechanical ventilation (MV). APACHE II= Acute Physiology And Chronic Health Evaluation-II score, BMI= body mass index, RRT= renal replacement therapy, SAPS-II= Simplified Acute Physiology Score-II, TISS-28= Therapeutic Intervention Scoring System-28. Overall model fitness: $p<0.001$, $X^2=31.3$.

Table E3 Baseline demographics of extubated ICU patients (incl. subgroups)

	Total group				Emergency group			Elective group		
	all **n=933**	**Dysphagia screening positive** **n=116**	**Dysphagia screening negative** **n=817**	**p-value**	**Dysphagia screening positive** **n=96**	**Dysphagia screening negative** **n=429**	**p-value**	**Dysphagia screening positive** **n=20**	**Dysphagia screening negative** **n=388**	**p-value**
Age (years)	65 [54-73.3]	64.5 [49.5-77.0]	65.0 [55.0-73.0]	0.83	62.0 [49.0-75.5]	62.0 [51.0-71.0]	0.8	71.0 [55.5-78.0]	68.0 [59.0-74.0]	0.31
Gender (male, %)	666 (71)	80 (69)	586 (72)	0.58	68 (71)	292 (68)	0.63	12 (60)	294 (76)	0.12
Weight (kg)	80.0 [70.0-90.0]	76.0 [69.8-86.0]	80.0 [70.0-90.0]	0.07	78.0 [71.8-88.5]	80.0 [70.0-90.0]	0.43	68.5 [59.0-80.0]	80.0 [70.0-90.0]	**0.002**
BMI*	26.2 [23.7-29.4]	25.7 [23.5-27.8]	26.3 [23.7-29.3]	0.07	25.9 [24.2-28.4]	26.2 [23.5-29.4]	0.6	24.4 [21.4-26.5]	26.6 [24.0-29.4]	**0.008**
APACHE-II score	17 [13-23]	21 [17-25]	17 [13-22]	**<0.001**	21 [17-25]	20 [14-24.8]	**0.03**	21 [16.25-24.5]	15 [12-18]	**<0.001**
SAPS-II score	36 [28-46]	42.5 [34-55.5]	35 [28-45]	**<0.001**	41 [34-56]	41 [33-52]	0.35	49.5 [36.5-54.5]	30 [25-38]	**<0.001**
APACHE-IV admission diagnostic groups (number, %)										
- Cardiovascular	556 (59.6)	34 (29.3)	522 (63.9)	**<0.001**	20 (20.8)	155 (36.1)	**0.004**	14 (70.0)	367 (94.6)	**<0.001**
- Respiratory	52 (5.6)	6 (5.2)	46 (5.6)	1.0	5 (5.2)	45 (10.5)	0.13	1 (5.0)	1 (0.3)	0.1
- Gastrointestinal	56 (6.0)	5 (4.3)	51 (6.2)	0.53	5 (5.2)	43 (10.0)	0.17	-	8 (2.1)	-
- Neurologic	147 (15.8)	47 (40.5)	100 (12.2)	**<0.001**	44 (45.8)	91 (21.2)	**<0.001**	3 (15.0)	9 (2.3)	**0.02**
- Trauma	71 (7.6)	17 (14.7)	54 (6.6)	**0.005**	17 (17.7)	53 (12.4)	0.18	-	1 (0.2)	-
- Metabolic	2 (0.2)	-	2 (0.3)	-	-	2 (0.5)	-	-	-	-
- Hematological	4 (0.4)	2 (1.7)	2 (0.3)	0.08	2 (2.1)	2 (0.5)	0.15	-	-	-
- Urological	5 (0.5)	1 (0.9)	4 (0.5)	0.49	-	3 (0.7)	-	1 (5.0)	1 (0.2)	0.1
- Diverse	31 (3.3)	2 (1.7)	29 (3.5)	0.41	1 (1.0)	29 (6.7)	**0.03**	1 (5.0)	-	-
- Intoxication	9 (1.0)	2 (1.7)	7 (0.9)	0.31	2 (2.1)	6 (1.4)	0.64	-	1 (0.2)	-
Post-operative (%)	569 (61)	44 (38)	525 (64)	**<0.001**	28 (29)	161 (38)	0.1	16 (80)	364 (94)	**0.04**

Table 2 Resource use, length of stay, and clinical outcomes (incl. subgroups)

	Total group				Emergency group			Elective group		
	all **n=933**	**Dysphagia screening positive** **n=116**	**Dysphagia screening negative** **n=817**	**p-value**	**Dysphagia screening positive** **n=96**	**Dysphagia screening negative** **n=429**	**p-value**	**Dysphagia screening positive** **n=20**	**Dysphagia screening negative** **n=388**	**p-value**
Days on invasive MV*	0.7 [0.5-1.3]	1.2 [0.6-3.3]	0.7 [0.5-1.1]	**<0.001**	1.2 [0.6-3.2]	0.7 [0.4-1.7]	**0.002**	1.7 [0.8-4.0]	0.6 [0.5-0.8]	**<0.001**
Days on feeding tube	0.6 [0.4-2.3]	4.5 [1.7-6.8]	0.6 [0.3-1.5]	**<0.001**	4.5 [1.9-6.7]	1.0 [0.4-3.1]	**<0.001**	4.3 [1.6-7.5]	0.5 [0.3-0.7]	**<0.001**
Days on nasogastric tube	0.6 [0.4-2.0]	4.2 [1.6-6.4]	0.6 [0.3-1.4]	**<0.001**	4.1 [1.5-6.3]	0.9 [0.4-3.0]	**<0.001**	4.7 [1.6-7.8]	0.5 [0.3-0.7]	**<0.001**
Days on antibiotics	1.0 [0.0-2.0]	1.0 [1.0-4.5]	1.0 [0.0-2.0]	**0.04**	1.0 [1.0-6.0]	1.0 [0.0-2.0]	**0.004**	1.0 [0.0-1.0]	1.0 [0.0-2.0]	0.29
Days on antimicrobials	1.0 [0.0-2.0]	1.0 [1.0-4.5]	1.0 [0.0-2.0]	**0.04**	1.0 [1.0-6.0]	1.0 [0.0-2.0]	**0.003**	1.0 [0.0-1.0]	1.0 [0.0-2.0]	0.23
Days on vasopressors	0 [0-0.5]	0.005 [0-0.8]	0 [0-0.5]	0.35	0.02 [0-0.9]	0 [0-0.48]	0.16	0 [0-0.4]	0 [0-0.49]	0.41
Days on adrenaline	0 [0-0]	0 [0-0.1]	0 [0-0]	**0.008**	0 [0-0.1]	0 [0-0]	**0.003**	0 [0-0]	0 [0-0]	0.93
Days on noradrenaline	0 [0-0.3]	0 [0-0.5]	0 [0-0.3]	0.47	0 [0-0.7]	0 [0.30]	0.24	0 [0-0.6]	0 [0-0.22]	0.27
Pts. on vasopressors (%)	494 (52.9%)	64 (55.2%)	431 (52.8%)	0.7	55 (57.3%)	222 (51.8%)	0.37	9 (45%)	208 (53.6%)	0.5
Pts. on RRT† (%)	47 (5.0%)	12 (10.3%)	35 (4.3%)	**0.01**	8 (8.3%)	29 (6.8%)	0.66	4 (20%)	6 (1.5%)	**0.001**
Cumulative TISS-28 points	124 [98-260]	344 [183-758]	119 [94-223]	**<0.001**	310 [139-631]	164 [92-335]	**<0.001**	581 [262-968]	114 [99-134]	**<0.001**
ICU LOS‡ total days	1.0 [0.8-2.2]	2.9 [1.6-6.0]	0.9 [0.8-1.8]	**<0.001**	2.7 [1.5-5.3]	1.3 [0.7-2.9]	**<0.001**	4.3 [2.0-7.9]	0.9 [0.8-1.0]	**<0.001**
ICU LOS‡ until extubation	0.5 [0.3-1.2]	1.2 [0.4-3.3]	0.5 [0.3-0.9]	**<0.001**	1.2 [0.4-3.2]	0.6 [0.3-1.6]	**0.002**	1.4 [0.5-3.6]	0.4 [0.3-0.6]	**<0.001**
ICU LOS‡ after extubation	0.5 [0.3-0.9]	1.1 [0.7-2.5]	0.5 [0.3-0.8]	**<0.001**	1.0 [0.6-2.3]	0.6 [0.3-1.0]	**<0.001**	1.7 [1.0-3.0]	0.5 [0.3-0.6]	**<0.001**
Hospital LOS‡ (days)	11.0 [8.0-17.6]	17.9 [7.8-24.9]	10.2 [8.0-15.8]	**<0.001**	15.5 [6.5-23.7]	10.4 [5.6-18.9]	**0.008**	22.4 [18.8-25.9]	10.2 [8.4-14.0]	**<0.001**
All-cause ICU mortality	8 (0.9%)	2 (1.7%)	6 (0.7%)	0.3	1 (1.0%)	5 (1.2%)	1.0	1 (5.0%)	1 (0.3%)	0.1
All-cause hospital mortality	22 (2.4%)	9 (7.8%)	13 (1.6%)	**0.001**	7 (7.3%)	10 (2.3%)	**0.02**	2 (10.0%)	3 (0.8%)	**0.02**
All-cause 28-day mortality	35 (3.8%)	11 (9.5%)	24 (2.9%)	**0.002**	9 (9.4%)	20 (4.7%)	0.08	2 (10.0%)	4 (1.0%)	**0.03**
All-cause 90-day mortality	45 (4.8%)	15 (12.9%)	30 (3.7%)	**<0.001**	13 (13.5%)	24 (5.6%)	**0.01**	2 (10.0%)	6 (1.6%)	0.05

Confirmatory cohort: Demographics, resource use, and clinical outcomes in ICU patients with/ without confirmed dysphagia

Data from 220 ICU patients post MV treated at an independent academic center (please refer to methods section) were analyzed for confirmatory purposes regarding incidence by speech language therapists. Baseline demographical data (median/ IQR): age 65 [56-73] years, 69% male, 36.4% emergencies, BMI 27.7 [24.7-31.2], APACHE II score 16.0 [13.0-19.75], SAPS II score 28.0 [23.0-36.0], days on mechanical ventilation 0.53 [0.40-0.92], days on vasopressors 0.3 [0-0.9], ICU-/ hospital- length of stay 1.0 [0.9-2.85]/ 7.3 [5.3-10.8] days, ICU-/ hospital- mortality rate 1.8%/4.1%. Number of patients per respective APACHE IV admission category (patients with both non-operative and operative category are given): cardiovascular n=16/146, respiratory n=5/0, gastrointestinal n=2/7, neurological n=13/8, trauma n=4/7, intoxication n=6/3, urological n=0/2, others n=1/0 (83% of cases in cardiovascular or neurological category). In the confirmatory cohort, confirmed dysphagia positive patients had more days on enteral nutrition (0.7 [0-4.1] days (dysphagia group) *vs*. 0 [0-0] without dysphagia group, p<0.001), and days on antibiotics (4.28 [2.08-7.39] *vs*. 0.69 [0.66-1.52] days, p<0.001, respectively). When compared to patients without dysphagia, ICU- and hospital length of stay was longer in the dysphagia group: ICU length of stay 4.8 [3.1-7.85] *vs*. 1.0 [0.9-1.95] days, p<0.001), and hospital length of stay 8.9 [6.8-17.95] *vs*. 7.0 [5.3-10.1] days, p=0.02, respectively. When comparing the two (i.e. main and confirmatory) patient cohorts, it appeared that they did not differ in regard to patient age, gender, and disease severity. In the confirmatory cohort, we observed a higher rate of elective admission, more frequent admission for cardiovascular disease, and a shorter overall hospital length of stay.