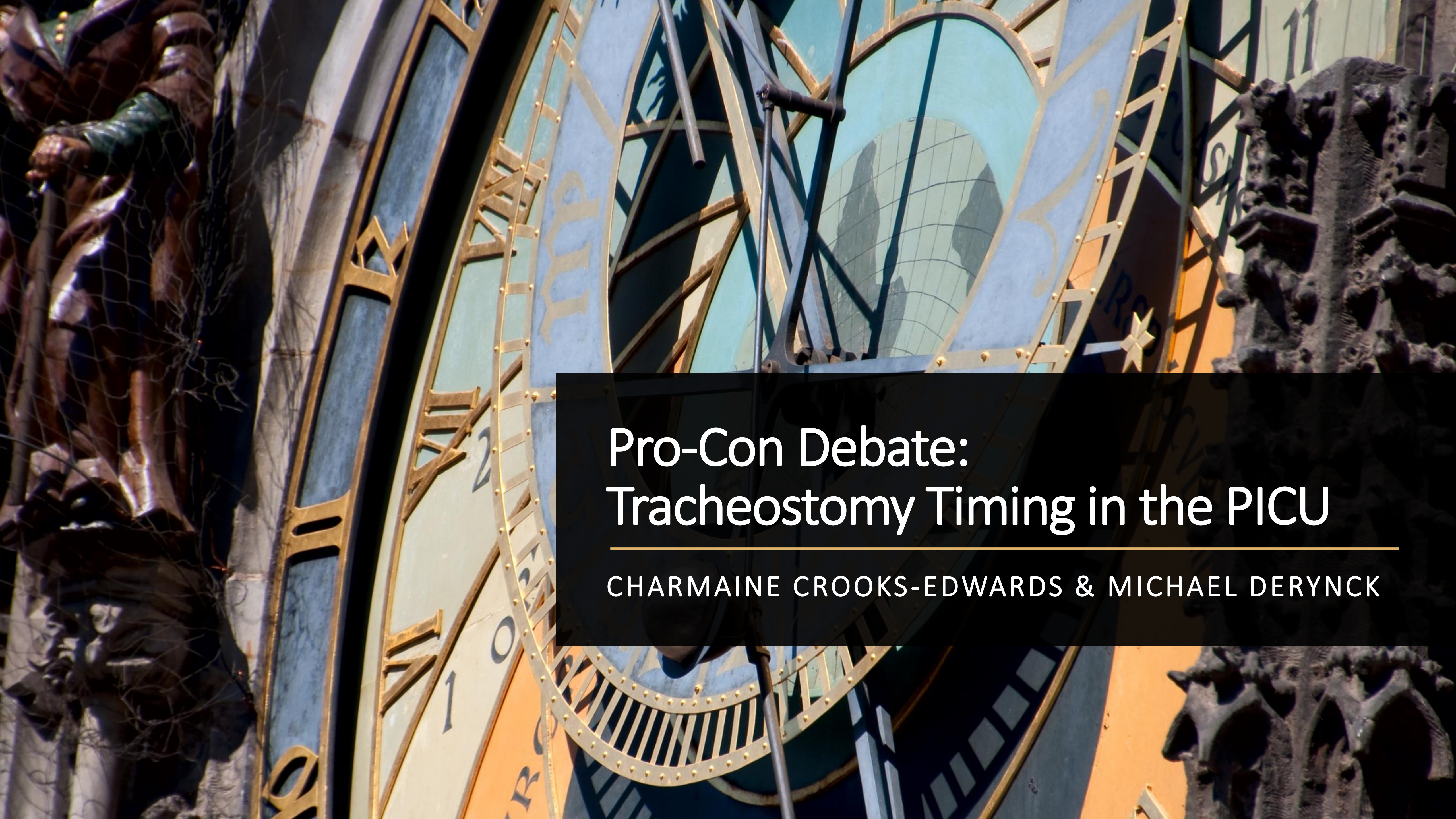


Pro-Con Debate: Tracheostomy Timing in the PICU

CHARMAINE CROOKS-EDWARDS & MICHAEL DERYNCK

Objectives

Tracheostomy overview

Benefits of early tracheostomy

Benefits of late tracheostomy





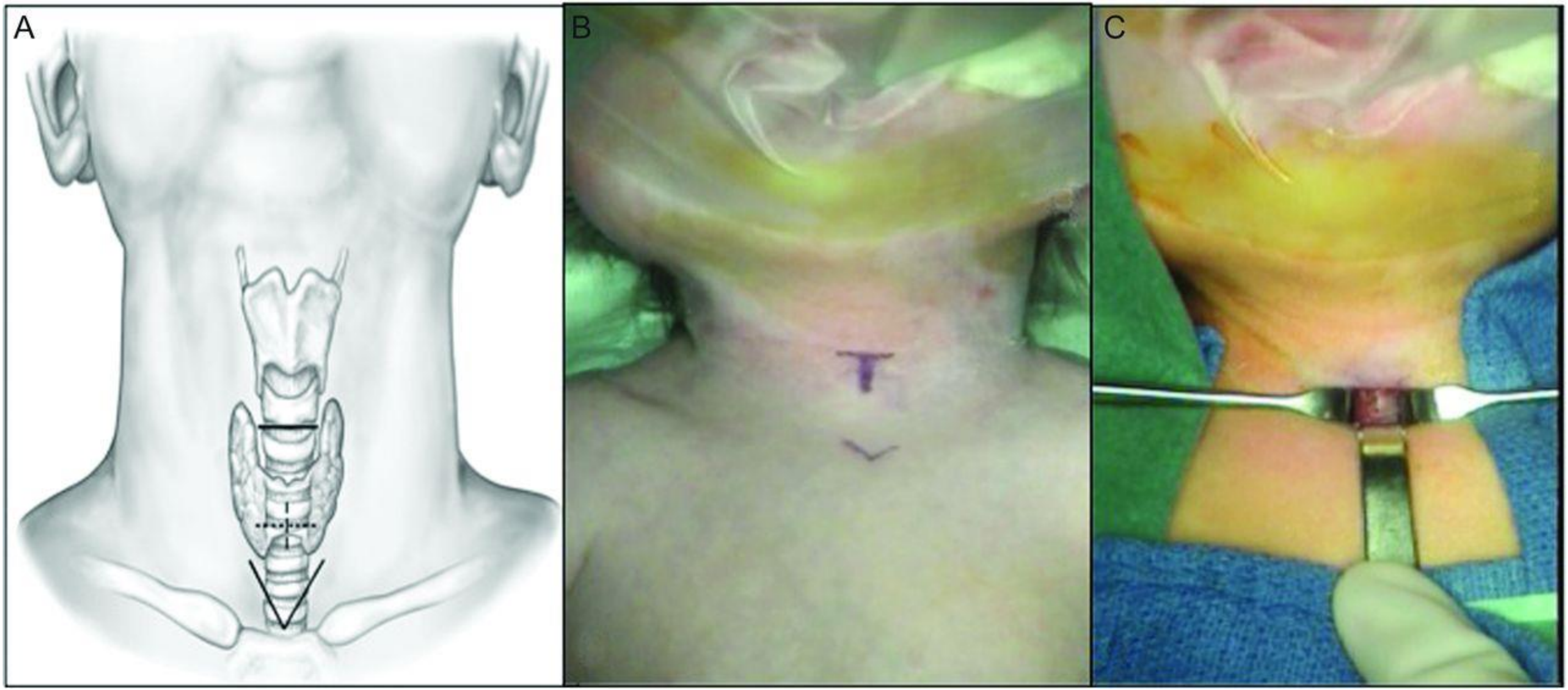
Tracheostomy

Life saving procedure

Varied indications

- Acute airway management
- Upper airway obstruction
- Lower airway ventilation / access

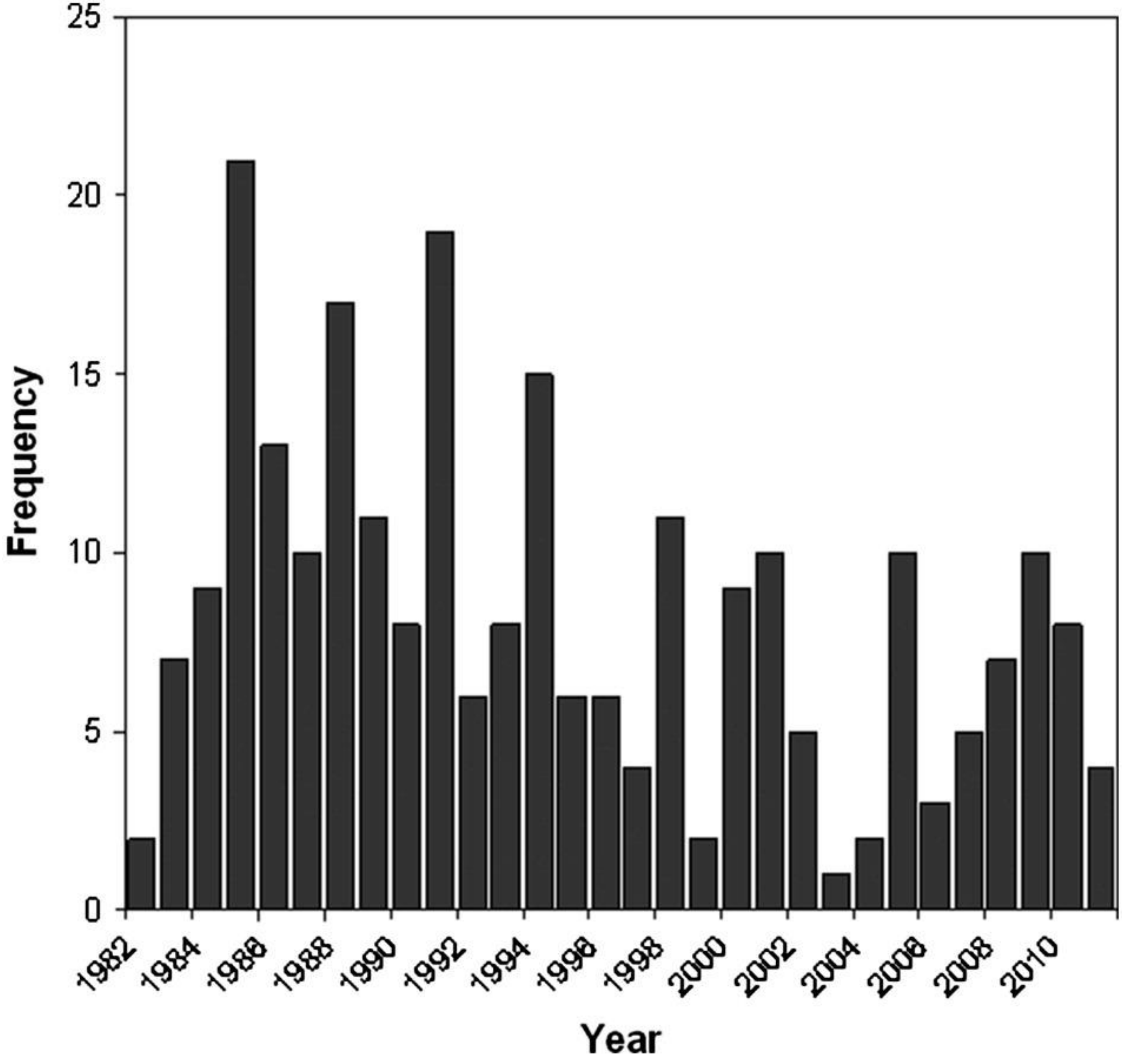
Al-Samri, M et al. Ped Pulm. 2010; Campisi, P & Forte, V. Semin Pediatr Surg. 2016



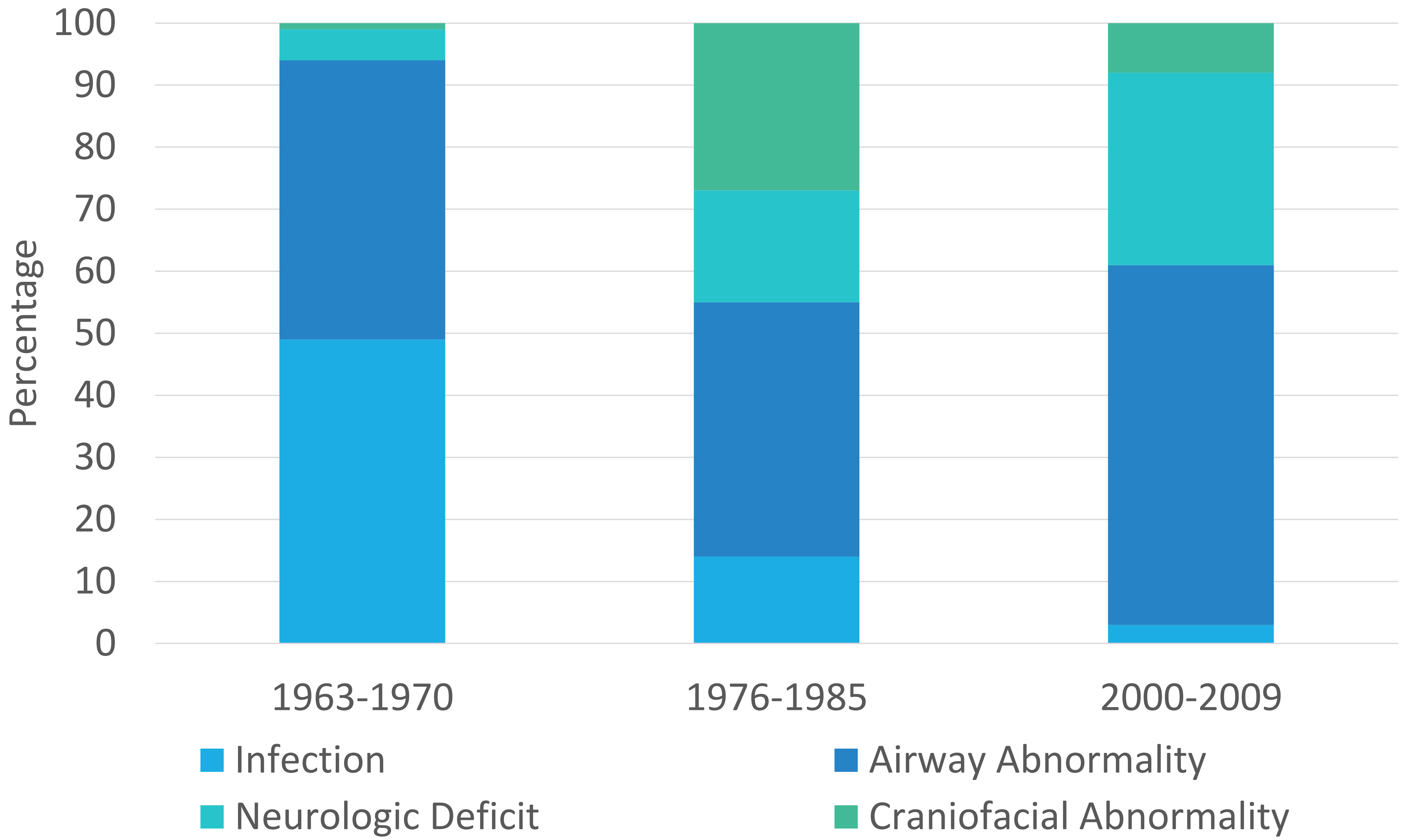
Watters, KF. Resp Care. 2017

Mehta, C & Mehta, Y. ACA. 2017

Jackson, C. The Life of Chevalier Jackson: An Autobiography. 1938



Ogilvie, L et al. J Pediatr Surg. 2014

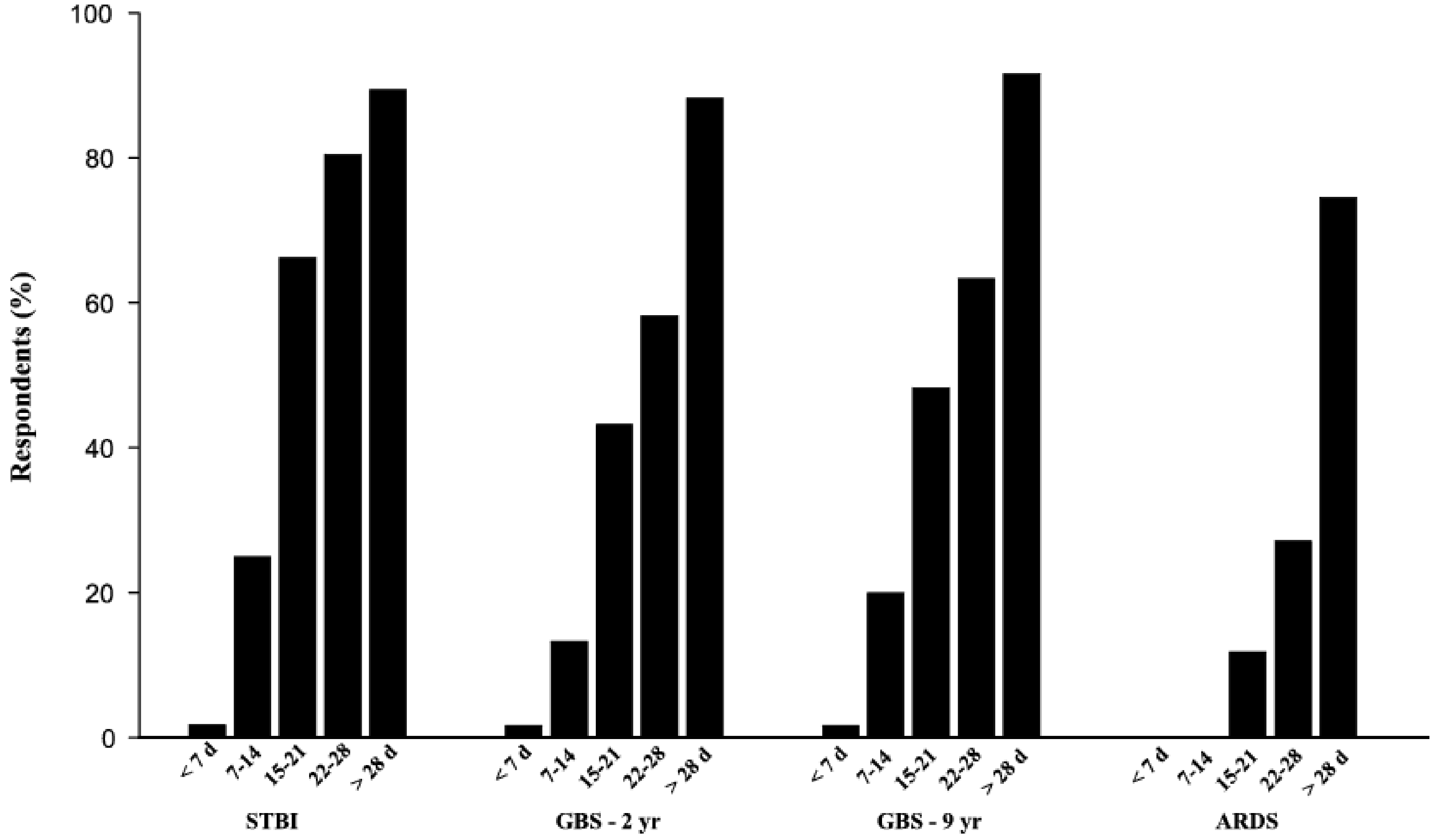


Campisi, P & Forte, V. Semin Pediatr Surg. 2016

To trach,

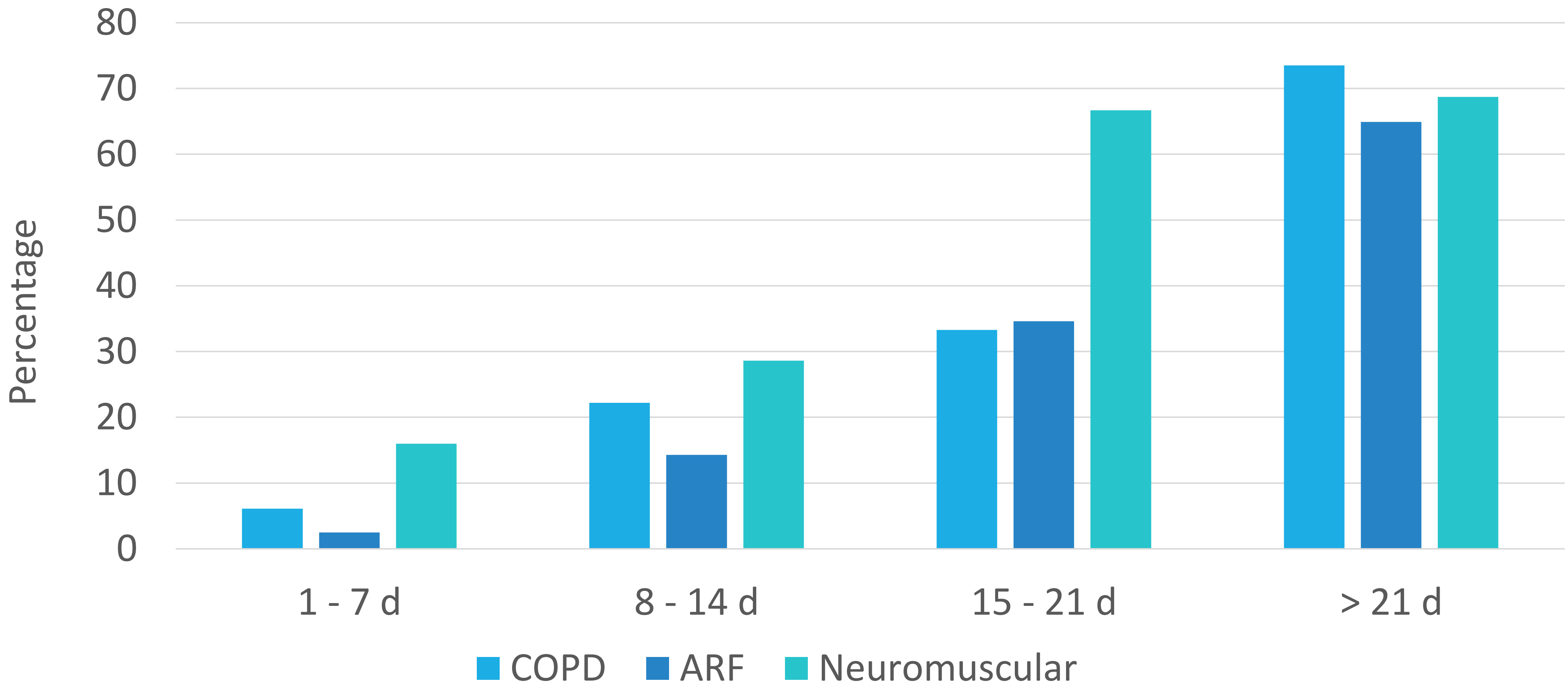
or not to trach. . .

PICU



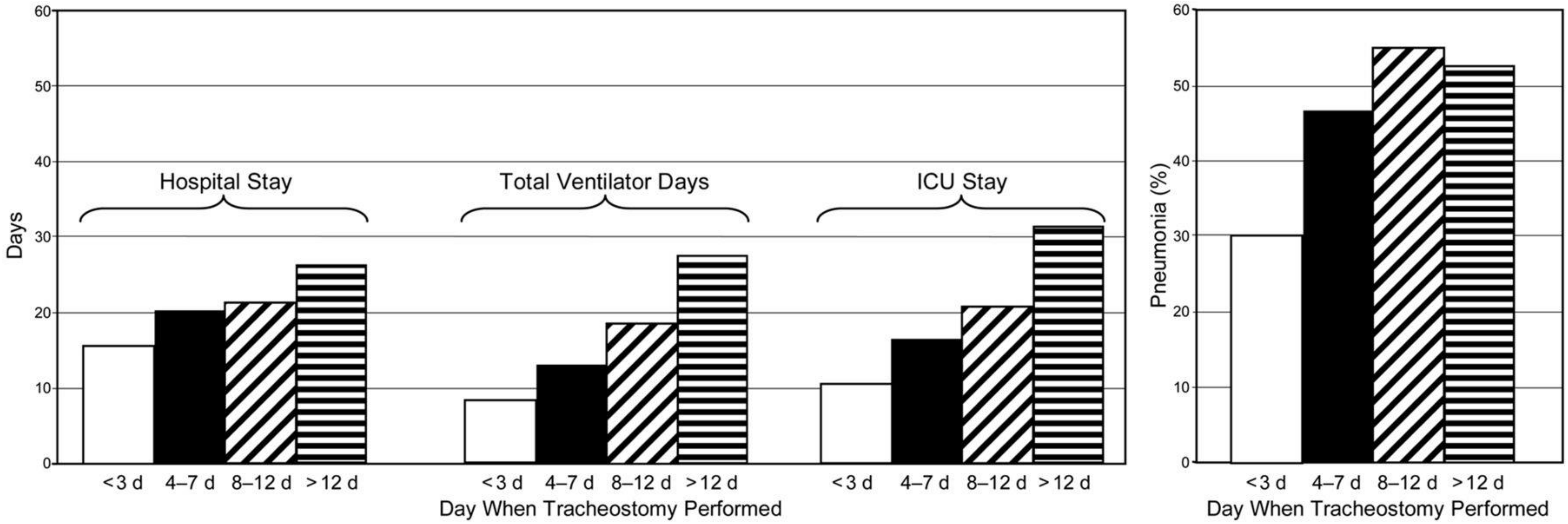
Matsui, D et al. Intensive Care Med. 2008; Wood, D et al. Arch Dis Child 2012

Adult ICU



Esteban, A et al. AJRCCM. 2000; Durbin, CG Jr. et al. Respir Care. 2010

Adult ICU



Durbin, CG Jr. et al. Respir Care. 2010

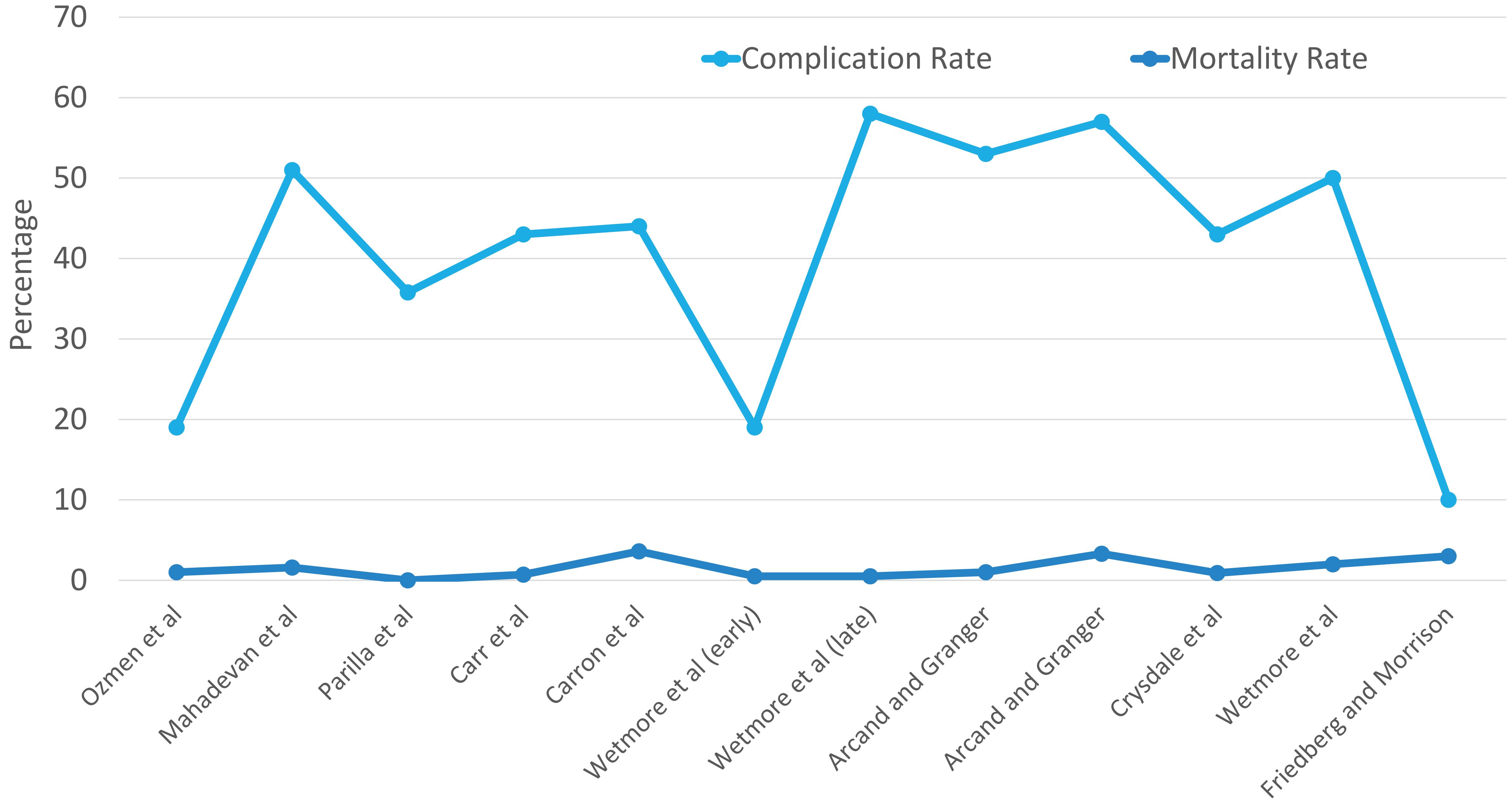

TIME TO GO!


THE BIG
DEBATE

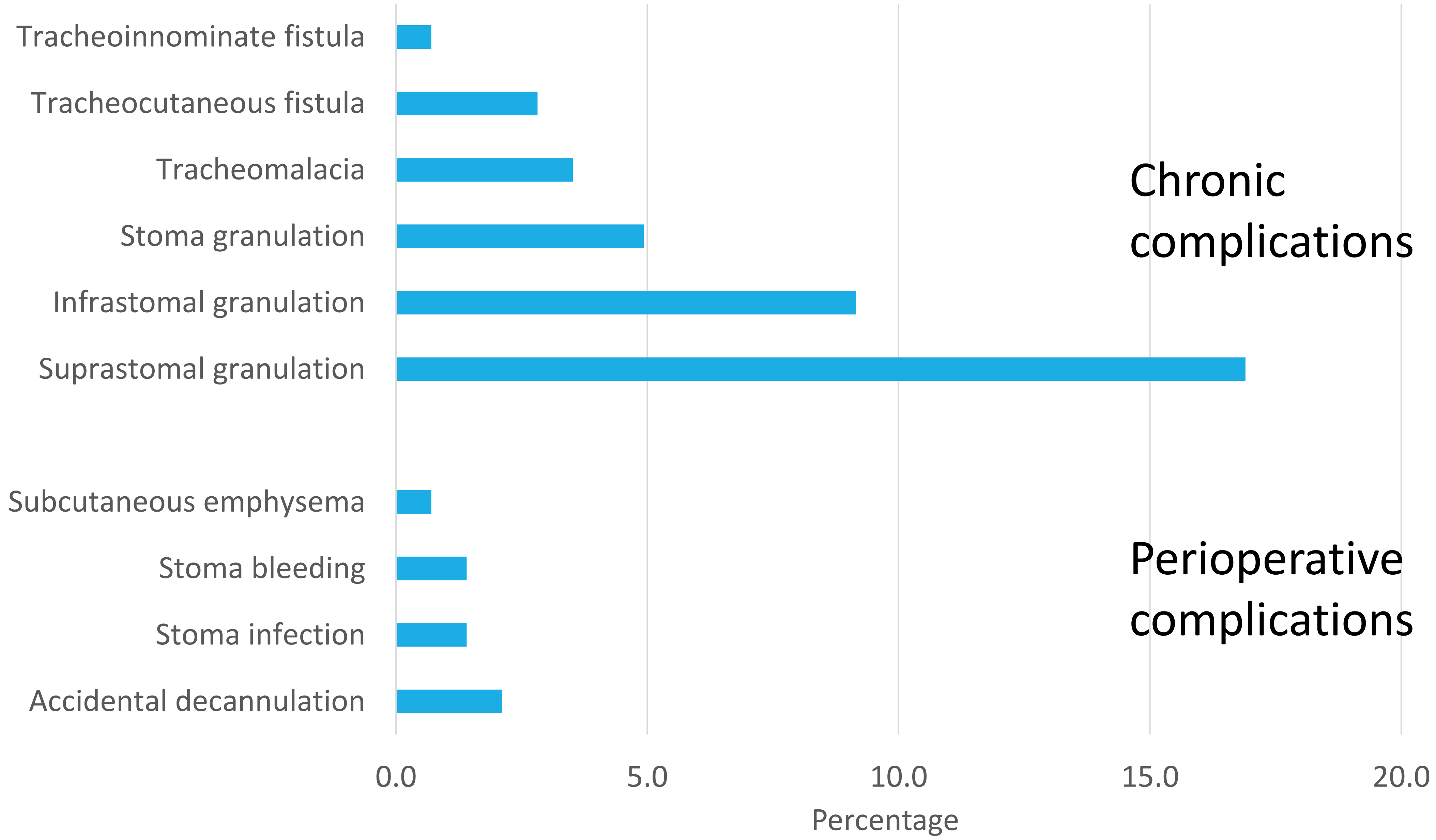
Early tracheostomy is beneficial in the pediatric population

MICHAEL DERYNCK

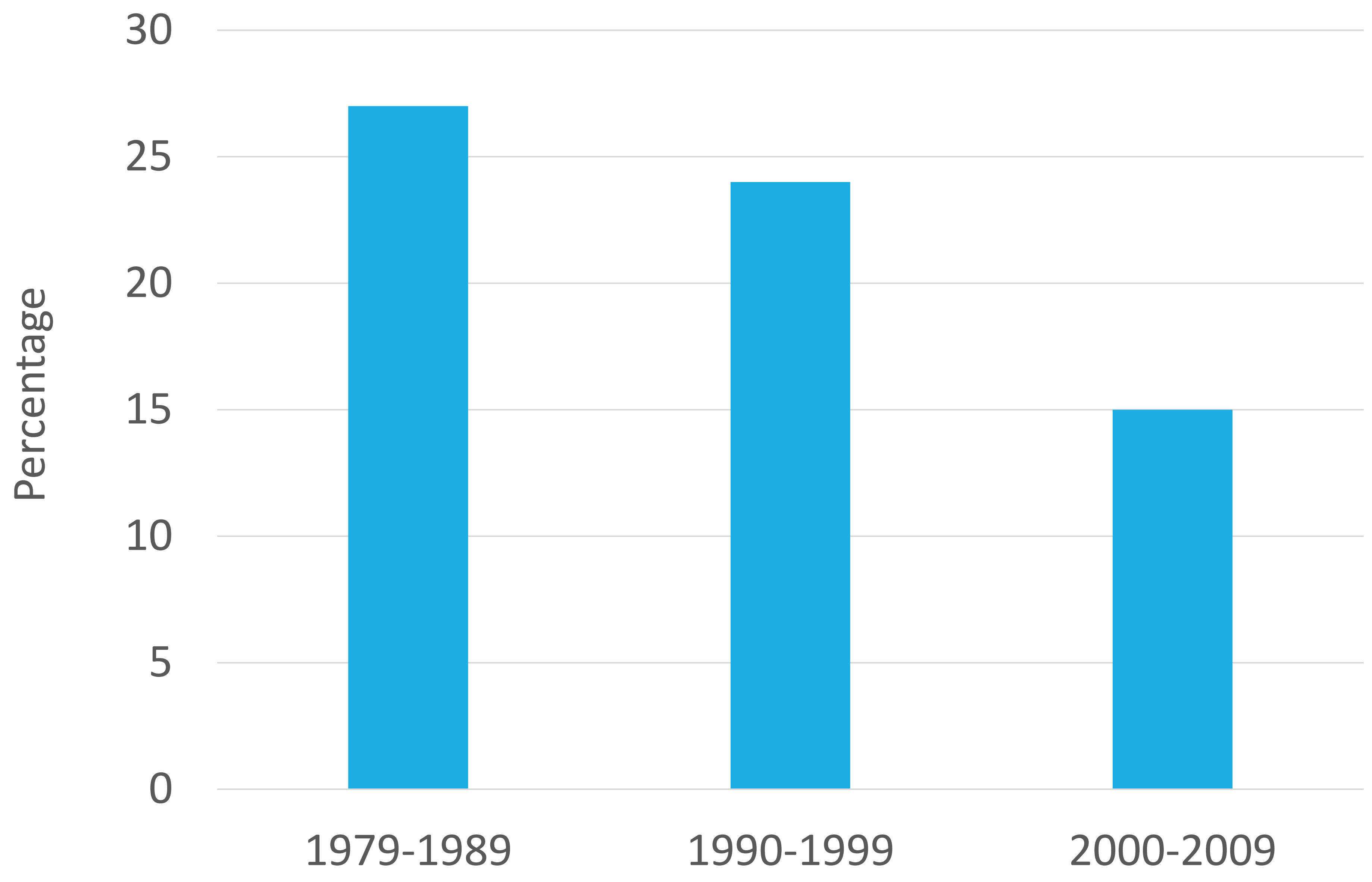

Tracheostomy is safe



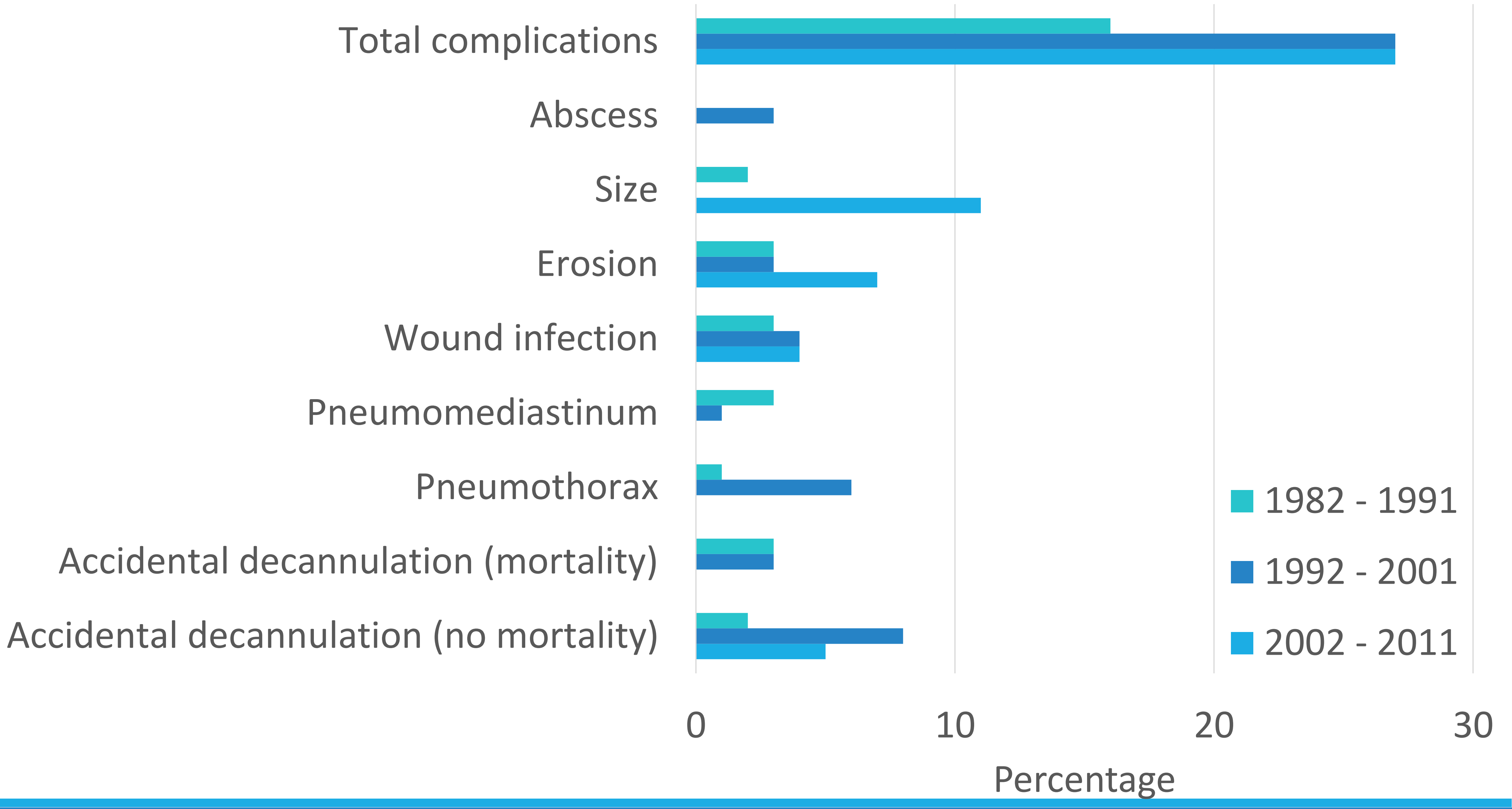
Campisi, P & Forte, V. Semin Pediatr Surg. 2016



Lin, C et al. Int J Pediatr Otorhinolaryngol. 2017



De Trey, L et al. J Pediatr Surg. 2013



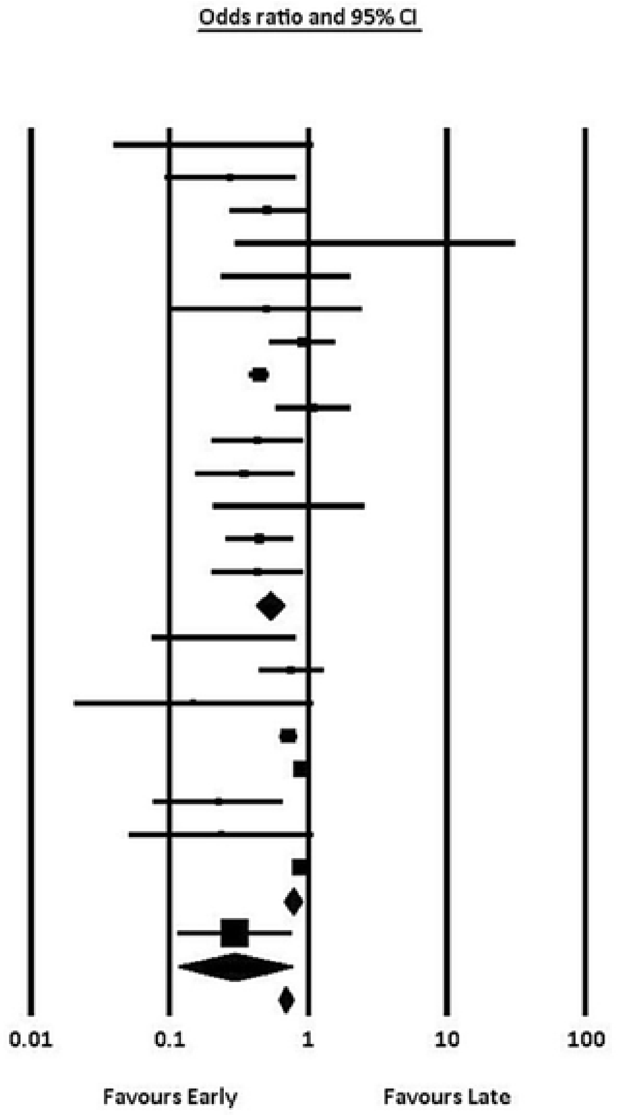
Ogilvie, L et al. J Pediatr Surg. 2014

Early tracheostomy improves health outcomes

Incidence of HAP

Group by WEEK	Study name	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value
1st week	Rodriguez et al 1990	0.21	0.04	1.09	-1.86	0.06
1st week	Rumback et al 2004	0.27	0.09	0.81	-2.34	0.02
1st week	Moller et al 2005	0.51	0.27	0.95	-2.12	0.03
1st week	Barquist et al 2006	3.00	0.29	30.62	0.93	0.35
1st week	Ahmed & Kuo 2007	0.69	0.24	2.00	-0.69	0.49
1st week	Pinheiro et al 2010	0.50	0.10	2.43	-0.86	0.39
1st week	Zagli et al 2010	0.90	0.53	1.55	-0.37	0.71
1st week	Risk et al 2011	0.44	0.38	0.51	-10.69	0.00
1st week	Ganuza et al 2011	1.08	0.59	1.98	0.24	0.81
1st week	Yue et al 2012	0.43	0.20	0.91	-2.20	0.03
1st week	Koch et al 2012	0.34	0.15	0.78	-2.57	0.01
1st week	Tong et al 2012	0.72	0.20	2.52	-0.52	0.61
1st week	Terragni et al 2010	0.44	0.26	0.77	-2.90	0.00
1st week	Gessler et al 2015	0.43	0.20	0.91	-2.21	0.03
1st week		0.53	0.42	0.66	-5.48	0.00
2nd week	Wanga et al 2012	0.25	0.08	0.80	-2.33	0.02
2nd week	Devarajan et al 2012	0.75	0.44	1.27	-1.08	0.28
2nd week	Choi et al 2013	0.15	0.02	1.08	-1.88	0.06
2nd week	Villwock et al 2014	0.71	0.62	0.82	-4.92	0.00
2nd week	Villwock & Jones 2014	0.90	0.85	0.94	-4.09	0.00
2nd week	Alhajhusain et al 2014	0.22	0.08	0.65	-2.76	0.01
2nd week	Jeon et al 2014	0.24	0.05	1.08	-1.86	0.06
2nd week	Keenan et al 2015	0.88	0.81	0.95	-3.19	0.00
2nd week		0.78	0.67	0.90	-3.39	0.00
3rd week	Mohafza et al 2012	0.29	0.12	0.75	-2.57	0.01
3rd week		0.29	0.12	0.75	-2.57	0.01
Overall		0.68	0.60	0.77	-6.09	0.00

Statistics for each study



Hospital Acquired Pneumonia

Adly, A et al. Eur Arch Otorhinolaryngol. 2018

Incidence of HAP

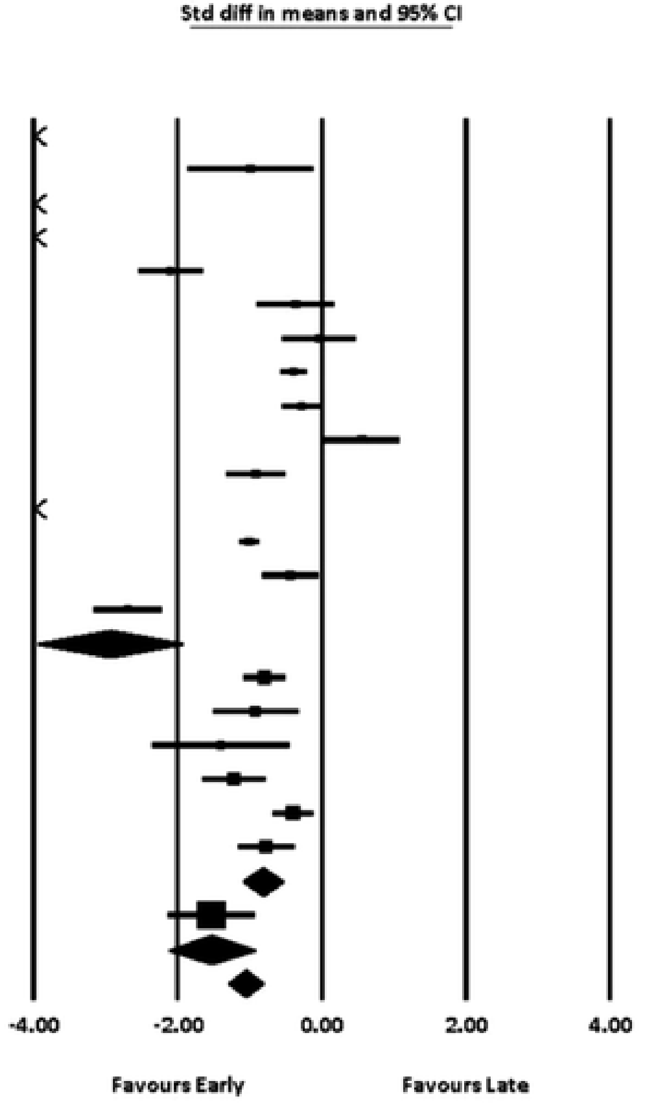
Study name	Statistics for each study				
	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value
Holscher et al 2014	0.22	0.04	1.33	-1.65	0.10
Lee et al 2016	0.40	0.04	4.54	-0.74	0.46
	0.27	0.06	1.15	-1.76	0.08

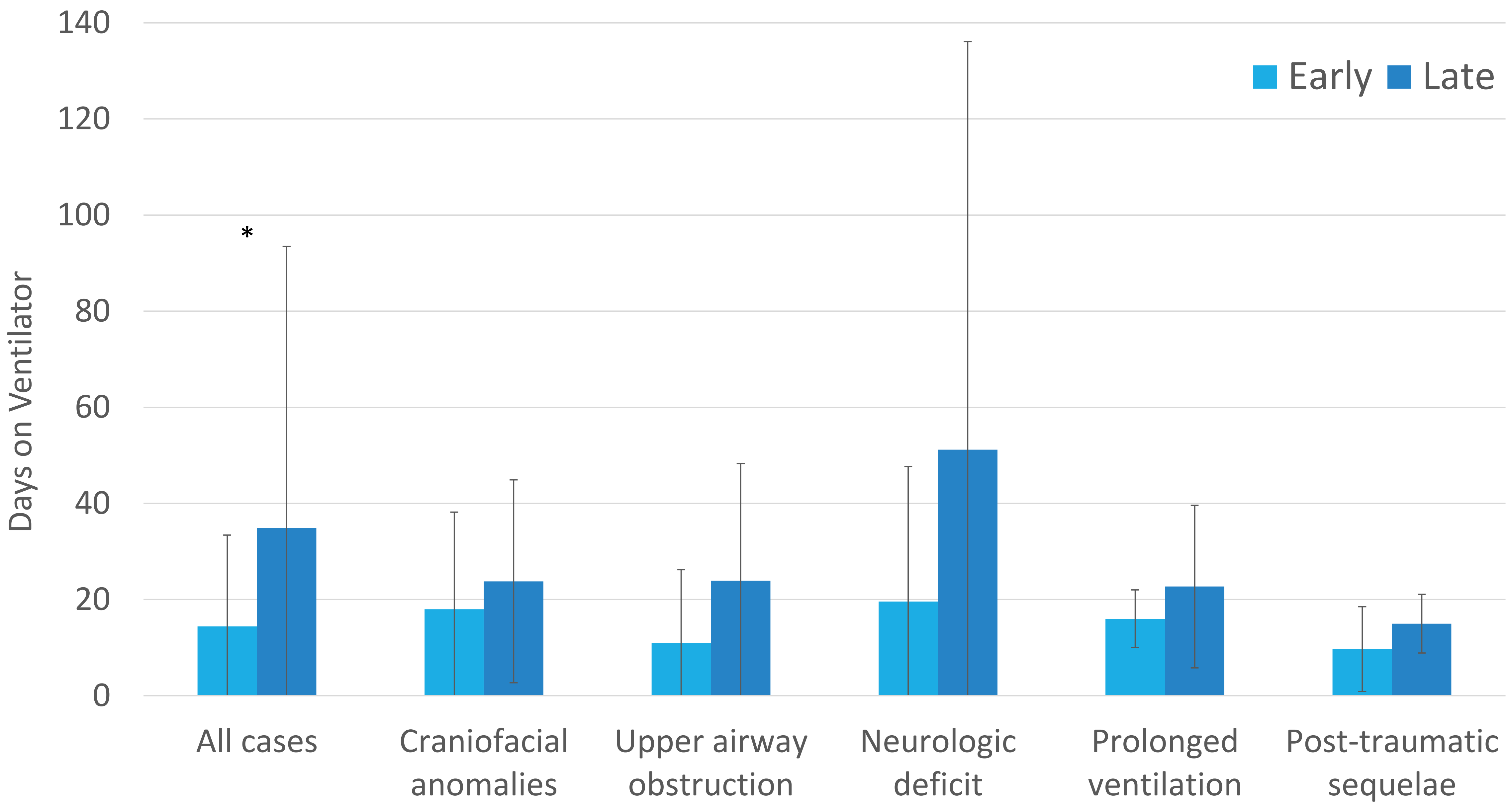
Odds ratio and 95% CI

Adly, A et al. Eur Arch Otorhinolaryngol. 2018

Duration of Mechanical Ventilaton

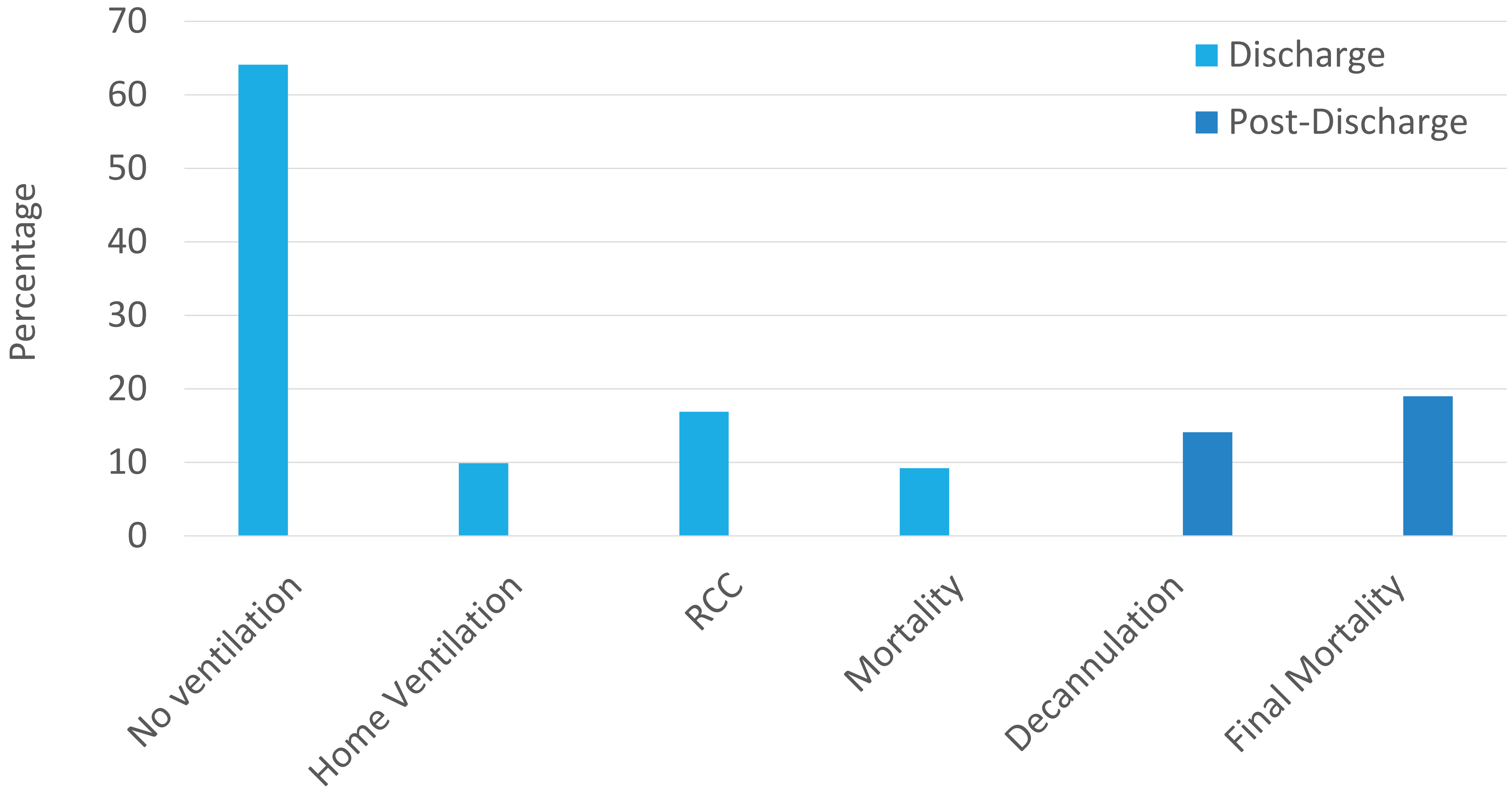
Group by WEEK	Study name	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
1st week	Rodriguez et al 1990	-8.81	0.64	0.40	-10.06	-7.56	-13.86	0.00
1st week	Gatti et al 2004	-0.98	0.44	0.19	-1.84	-0.12	-2.24	0.03
1st week	Arabi et al 2004	-7.11	0.48	0.23	-8.05	-6.17	-14.84	0.00
1st week	Moller et al 2005	-8.49	0.47	0.22	-9.40	-7.58	-18.24	0.00
1st week	Rumbak et al 2004	-2.09	0.23	0.05	-2.53	-1.64	-9.20	0.00
1st week	Ahmed & Kuo 2007	-0.35	0.27	0.07	-0.89	0.18	-1.30	0.19
1st week	Barquist et al 2006	-0.03	0.26	0.07	-0.54	0.48	-0.12	0.91
1st week	Zagli et al 2010	-0.38	0.09	0.01	-0.55	-0.20	-4.22	0.00
1st week	Ganuza et al 2011	-0.27	0.14	0.02	-0.53	0.00	-1.93	0.05
1st week	Bosel et al 2012	0.57	0.26	0.07	0.05	1.08	2.15	0.03
1st week	Koch et al 2012	-0.91	0.21	0.04	-1.32	-0.50	-4.32	0.00
1st week	Tong et al 2012	-12.23	0.37	0.14	-12.95	-11.51	-33.13	0.00
1st week	Alali et al 2014	-1.00	0.06	0.00	-1.12	-0.87	-15.89	0.00
1st week	Hyde et al 2014	-0.43	0.20	0.04	-0.81	-0.04	-2.17	0.03
1st week	Gesssler et al 2015	-2.68	0.24	0.06	-3.16	-2.21	-11.03	0.00
1st week		-2.94	0.52	0.27	-3.95	-1.93	-5.71	0.00
2nd week	Bickenback et al 2011	-0.79	0.15	0.02	-1.08	-0.50	-5.29	0.00
2nd week	Wang et al 2012	-0.91	0.30	0.09	-1.49	-0.32	-3.05	0.00
2nd week	Choi et al 2012	-1.39	0.49	0.24	-2.35	-0.44	-2.86	0.00
2nd week	Alhajhusain et al 2014	-1.21	0.22	0.05	-1.65	-0.78	-5.50	0.00
2nd week	Ben-avi et al 2014	-0.39	0.14	0.02	-0.67	-0.11	-2.73	0.01
2nd week	Jeon et al 2014	-0.76	0.20	0.04	-1.15	-0.37	-3.83	0.00
2nd week		-0.82	0.14	0.02	-1.09	-0.55	-5.88	0.00
3rd week	Chen et al 2016	-1.53	0.30	0.09	-2.12	-0.93	-5.05	0.00
3rd week		-1.53	0.30	0.09	-2.12	-0.93	-5.05	0.00
Overall		-1.06	0.12	0.02	-1.30	-0.82	-8.61	0.00




Early
Late
Days on Ventilator
140
120
100
80
60
40
20
0
*
All cases
Craniofacial anomalies
Upper airway obstruction
Neurologic deficit
Prolonged ventilation
Post-traumatic sequelae

140 patients

SMD -0.99 (95% CI -1.45 to -0.52)



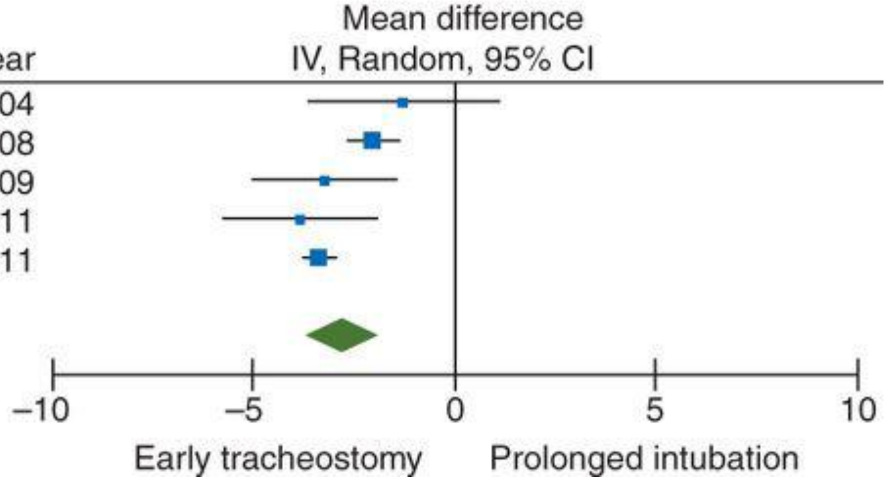
Lin, C et al. Int J Pediatr Otorhinolaryngol. 2017

Days of Sedation

Study or Subgroup	Early tracheostomy Mean	SD	Total	Prolonged intubation Mean	SD	Total	Weight	Mean difference IV, Random, 95% CI	Year
Blot et al 2008	12.5	6.75	61	13.75	6.75	62	10.1%	−1.25 (−3.64, 1.14)	2004
Young et al 2013	5	4.44	455	7	5.18	454	29.5%	−2.00 (−2.63, −1.37)	2008
Trouillet 2011	6.4	5.9	109	9.6	7.3	107	14.8%	−3.20 (−4.97, −1.43)	2009
Bosel 2012	7.19	3.4	29	11	4	29	13.5%	−3.81 (−5.72, −1.90)	2011
Zheng et al 2012	7.16	0.8	58	10.5	1.4	61	32.2%	−3.34 (−3.75, −2.93)	2011
Total (95% CI)			712			713	100.0%	−2.78 (−3.68, −1.88)	

Heterogeneity. $Tau^2 = 0.61$; $Chi^2 = 15.14$, $df = 4$ ($P = 0.004$); $I^2 = 74\%$

Test for overall effect: $Z = 6.05$ ($P < 0.00001$)

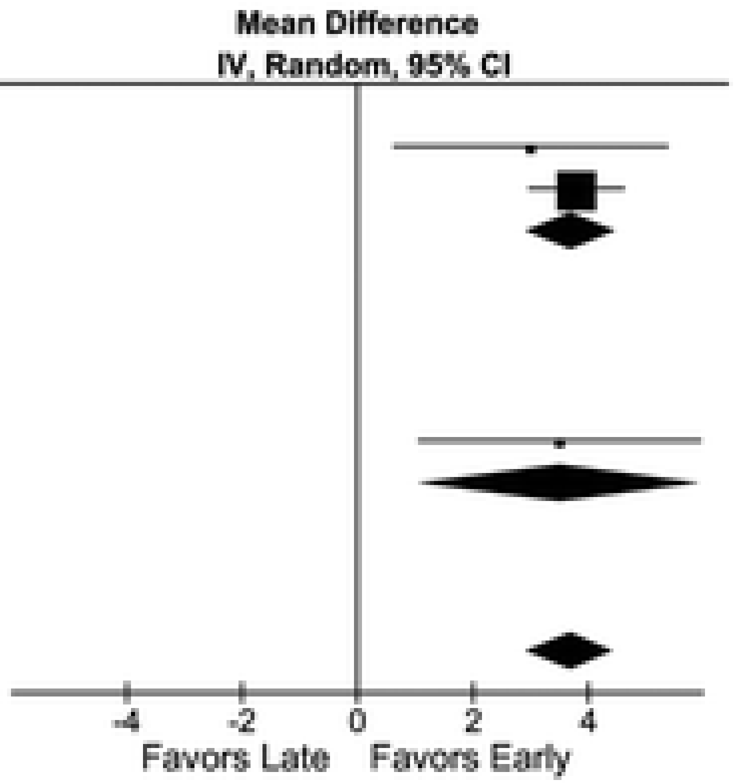


Szakmany, T et al. Br J Anaesth. 2015

Sedation Free Days

b)

Study or Subgroup	Early Mean	Early SD	Early Total	Late Mean	Late SD	Late Total	Weight	Mean Difference IV, Random, 95% CI	Year
Early, within 4 days; Late, after 10 days									
Blot 2008 [40]	18	6.75	61	15	6.75	62	9.9%	3.00 [0.61, 5.39]	2008
Zheng 2012 [41]	20.84	2.35	58	17.05	2.3	61	80.7%	3.79 [2.95, 4.63]	2012
Subtotal (95% CI)			**119**			**123**	**90.6%**	**3.70 [2.91, 4.49]**	
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.38$, $df = 1$ ($P = 0.54$); $I^2 = 0\%$									
Test for overall effect: $Z = 9.20$ ($P < 0.00001$)									
Early, within 10 days; Late, after 10 days									
Trouillet 2011 [18]	19	9.1	109	15.5	9.3	107	9.4%	3.50 [1.05, 5.95]	2011
Subtotal (95% CI)			**109**			**107**	**9.4%**	**3.50 [1.05, 5.95]**	
Heterogeneity: Not applicable									
Test for overall effect: $Z = 2.80$ ($P = 0.005$)									
Total (95% CI)			**228**			**230**	**100.0%**	**3.68 [2.93, 4.44]**	
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.40$, $df = 2$ ($P = 0.82$); $I^2 = 0\%$									
Test for overall effect: $Z = 9.61$ ($P < 0.00001$)									
Test for subgroup differences: $Chi^2 = 0.02$, $df = 1$ ($P = 0.88$), $I^2 = 0\%$									

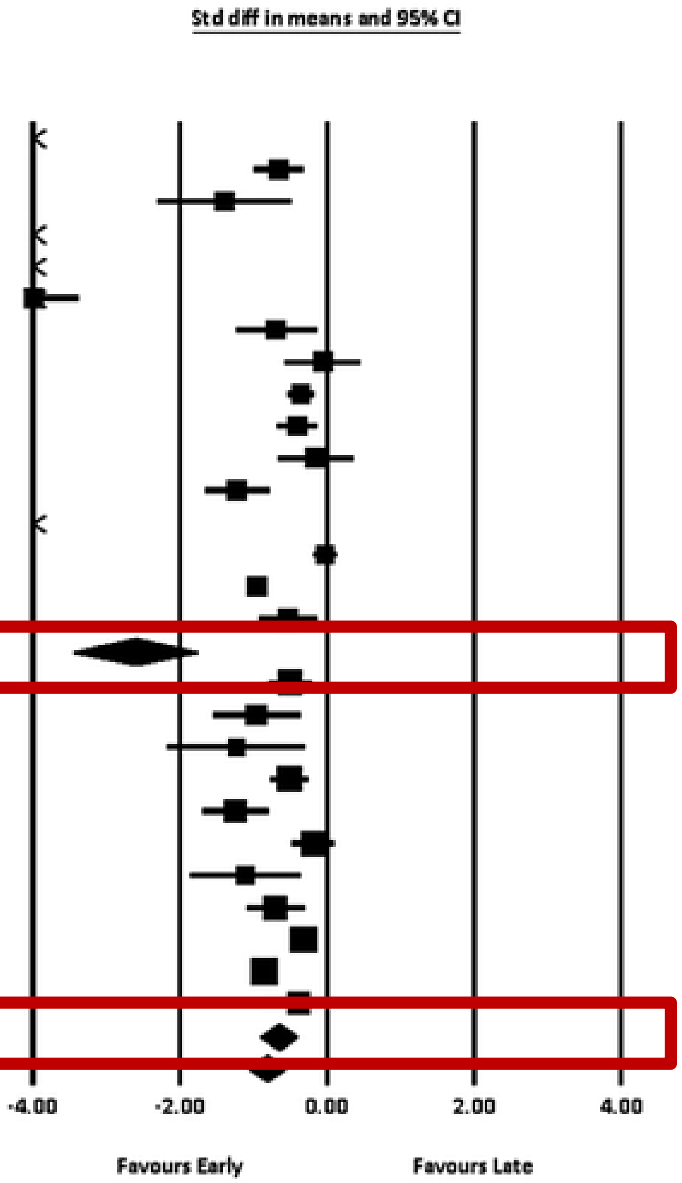


Endotracheal intubation	Tracheostomy
• Ease of placement • No surgery • Low initial cost / resource use	• Safety of reinsertion • Reduced laryngeal damage • Improved oral hygiene • Vocalization and communication • Improved patient comfort • Better swallowing function • Improved weaning from mechanical ventilation

Early tracheostomy improves healthcare resource utilization

ICU Length of Stay

Group by WEEK	Study name	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
1st week	Rodriguez et al 1990	-7.08	0.52	0.27	-8.11	-6.06	-13.52	0.00
1st week	Armstrong et al 1998	-0.65	0.17	0.03	-0.98	-0.32	-3.87	0.00
1st week	Gatti et al 2004	-1.39	0.46	0.21	-2.29	-0.49	-3.02	0.00
1st week	Arabi et al 2004	-7.89	0.52	0.27	-8.92	-6.87	-15.11	0.00
1st week	Moller et al 2005	-7.89	0.44	0.19	-8.75	-7.04	-18.09	0.00
1st week	Rumbak et al 2004	-3.98	0.32	0.10	-4.60	-3.36	-12.63	0.00
1st week	Ahmed and Kuo 2007	-0.68	0.28	0.08	-1.22	-0.14	-2.45	0.01
1st week	Barquist et al 2006	-0.05	0.26	0.07	-0.55	0.46	-0.19	0.85
1st week	Zagli et al 2010	-0.34	0.09	0.01	-0.52	-0.17	-3.88	0.00
1st week	Ganuza et al 2011	-0.40	0.14	0.02	-0.67	-0.13	-2.88	0.00
1st week	Bosel et al 2012	-0.15	0.26	0.07	-0.66	0.36	-0.58	0.56
1st week	Koch et al 2012	-1.21	0.22	0.05	-1.64	-0.79	-5.58	0.00
1st week	Tong et al 2012	-9.62	0.30	0.09	-10.20	-9.03	-32.40	0.00
1st week	Young et al 2013	-0.01	0.08	0.01	-0.17	0.14	-0.18	0.86
1st week	Alali et al 2014	-0.94	0.06	0.00	-1.07	-0.82	-15.12	0.00
1st week	Hyde et al 2014	-0.52	0.20	0.04	-0.90	-0.13	-2.62	0.01
1st week		-2.61	0.43	0.18	-3.44	-1.77	-6.10	0.00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2nd week	Wang et al 2012	-0.95	0.30	0.09	-1.53	-0.36	-3.17	0.00
2nd week	Chi et al 2012	-1.22	0.48	0.23	-2.16	-0.29	-2.57	0.01
2nd week	Devarajan et al 2012	-0.50	0.13	0.02	-0.77	-0.24	-3.74	0.00
2nd week	Alhajhusain et al 2014	-1.24	0.22	0.05	-1.67	-0.80	-5.59	0.00
2nd week	Ben-avi et al 2014	-0.18	0.14	0.02	-0.46	0.10	-1.27	0.21
2nd week	Huang et al 2013	-1.10	0.38	0.14	-1.84	-0.36	-2.90	0.00
2nd week	Jeon et al 2014	-0.69	0.20	0.04	-1.08	-0.30	-3.49	0.00
2nd week	Villwock et al 2014	-0.30	0.02	0.00	-0.34	-0.27	-17.14	0.00
2nd week	Villwock & Jones 2014	-0.83	0.01	0.00	-0.85	-0.82	-140.20	0.00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2nd week		-0.66	0.13	0.02	-0.91	-0.41	-5.13	0.00
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]



1st week

2nd week

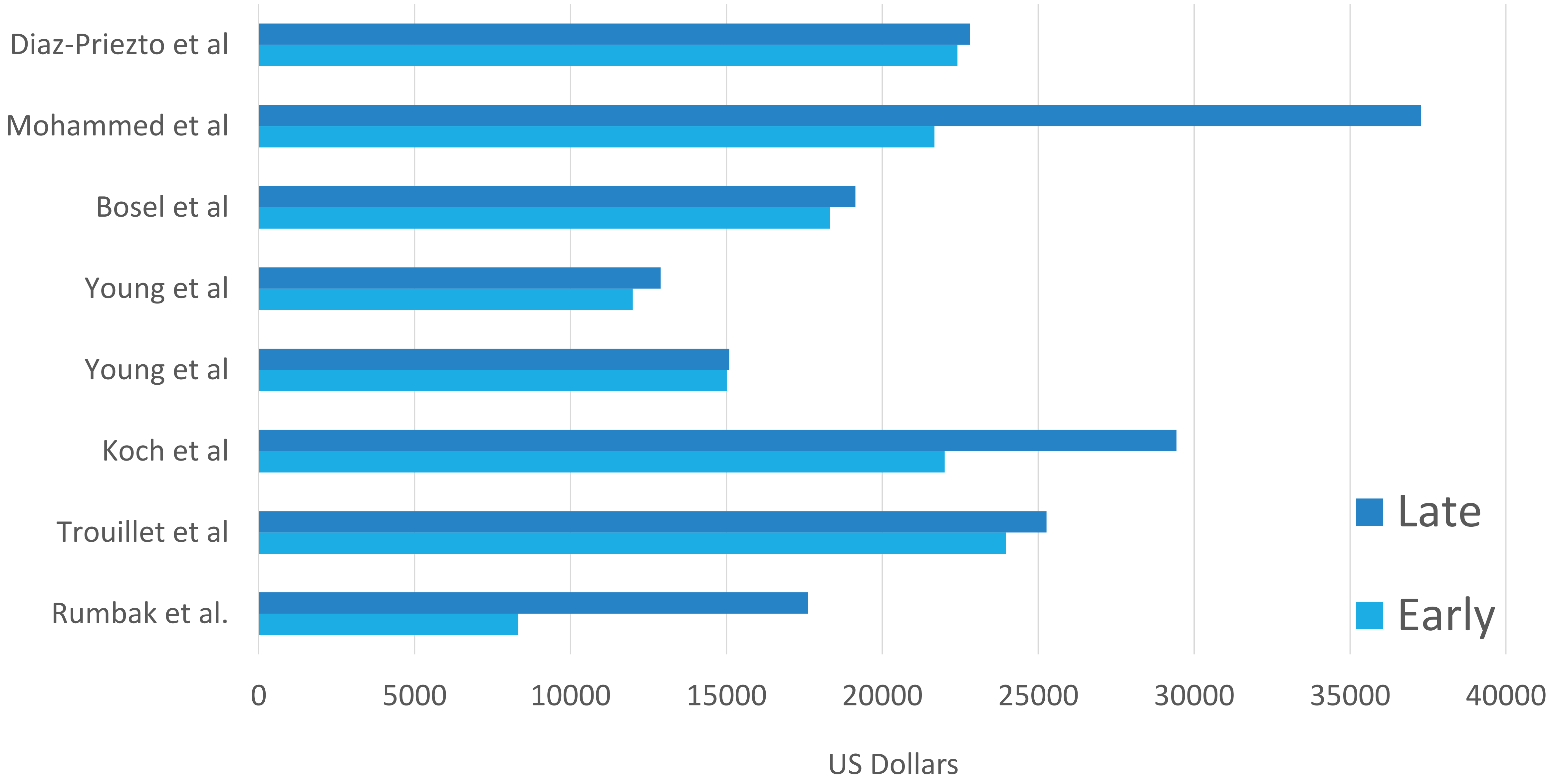
Length of Stay

	<14 days (N= 24)	≥ 14 days (N=49)	P
ICU	15 (7.5-22.5)	19 (12, 35)	0.047
Post-tracheostomy hospital	17 (13.5, 23.5)	22 (16, 41)	0.02
Total hospital	32 (25.5-47.5)	62 (45, 108)	<0.001

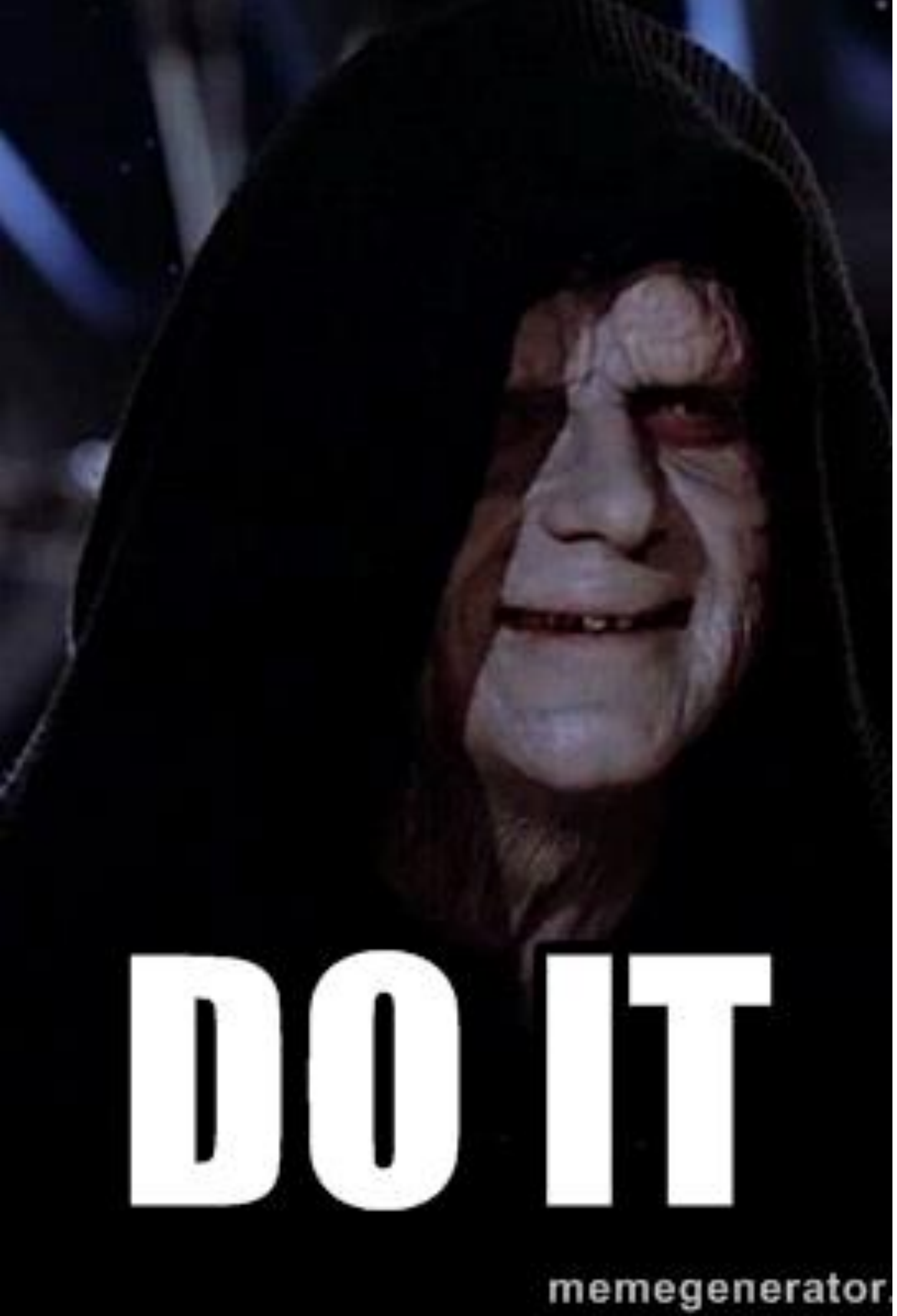
ICU Length of Stay

SMD -1.65 (95% CI -2.85 to -0.46)

Adly, A et al. Eur Arch Otorhinolaryngol. 2018



Herrit, B et al. J Crit Care. 2018



Early Tracheostomy

Low mortality

Few severe complications

Improved outcomes

- HAP (adult)
- Ventilator independence
- Sedation (adult)
- QOL

Decreased hospital resource use

Late tracheostomy / prolonged intubation

CHARMAINE CROOKS-EDWARDS

To Trach or Not to Trach?

Many considerations in decision making

- Individualised

When is the appropriate time?

Implications of tracheostomy

Indications for Tracheostomy

Prolonged Ventilation

Bypass upper airway obstruction

Airway protection

Pulmonary hygiene to manage secretions.

To Trach or Not to Trach?

More critically ill patients requiring prolonged mechanical ventilation (PMV)

- By 2020, estimated > 600,000 patients in the USA will require PMV [1]

Tracheostomy placement can facilitate this

Prolonged Ventilation

HOW LONG IS TOO LONG?

Prolonged Mechanical Ventilation

Great variability in terminology and definitions

- *National Association for Medical Direction of Respiratory Care (NAMDRC)*:

  "the need for more than 21 consecutive days of MV for more than 6 h/day".

- *European Respiratory Society (ERS) Task Force* : "the need of more than 7 days of weaning after the first spontaneous breathing trial (SBT)".

Variation in Definition

Reviewed studies with the term prolonged mechanical ventilation or a synonym

Most common terms:

- Prolonged mechanical ventilation (60%)
- Admission to specialized unit (26%)
- Long-term mechanical ventilation (19%)

Some authors (67%) defined cohorts based on duration of mechanical ventilation

- 55% used this as the sole criterion

Rose, L et al. Respiratory Care. 2017;62(10):1324-1332

Variation in Definition

Identified 37 different durations of ventilation

- ranging from 5 hours – 1 year
- > 21 days most common

Surgical cohorts:

- minimum ventilation duration required for inclusion
  - ≥ 24 hours for 20 of 66 studies (30%)

57% (237) of studies did not provide a reason/rationale for definitional criteria used

7% (28) of studies referred to a consensus definition

Rose, L et al. Respiratory Care. 2017;62(10):1324-1332

Conclusions

Substantial variation in terminology and definitional criteria for cohorts of subjects receiving prolonged mechanical ventilation

Standardisation is required for study data to be maximally informative

Early vs. Late

No overall consensus of exact timing

- Early: 48 hours – 10 days
- Late: > 10-14 days,
  21-28 days

Paucity of pediatric studies vs. adult cases

What determines the timeframe?

Does timing matter?

CLINICAL EVIDENCE

Effect of Early vs Late Tracheostomy Placement on Survival in Patients Receiving Mechanical Ventilation. The TracMan Randomized Trial

Objective:

- To test whether early vs late tracheostomy would be associated with lower mortality in adult patients requiring mechanical ventilation in critical care units.

Design & Setting:

- Open multicentered randomized clinical trial
- Conducted between 2004 – 2011
- Involving 70 adult general and 2 cardiothoracic critical care units in 13 university and 59 non-university hospitals in the United Kingdom.

Effect of Early vs Late Tracheostomy Placement on Survival in Patients Receiving Mechanical Ventilation. The TracMan Randomized Trial

Participants:

- 1032 eligible patients
  - 909 adult patients breathing with the aid of mechanical ventilation for < 4 days
  - Identified by the treating physician as likely to require at least 7 more days of mechanical ventilation.

Effect of Early vs Late Tracheostomy Placement on Survival in Patients Receiving Mechanical Ventilation. The TracMan Randomized Trial

Interventions:

- Patients randomized 1:1
  - Early tracheostomy (within 4 days) or
  - Late tracheostomy (after 10 days if still indicated).

Main Outcomes & Measures:

- The primary outcome measure was 30-day mortality and the analysis was by intention to treat.

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Results:

- Of 455 patients assigned to early tracheostomy, 91.9% (95% CI, 89.0%- 94.1%) received a tracheostomy
- Of 454 assigned to late tracheostomy, 44.9% (95% CI, 40.4%-49.5%) received a tracheostomy.

- **All-cause mortality 30 days** after randomization:
  - 30.8% (95% CI, 26.7%-35.2%) in the early
  - 31.5% (95% CI, 27.3%-35.9%) in the late group
    - (absolute risk reduction for early vs late, 0.7%; 95% CI, 5.4% to 6.7%).

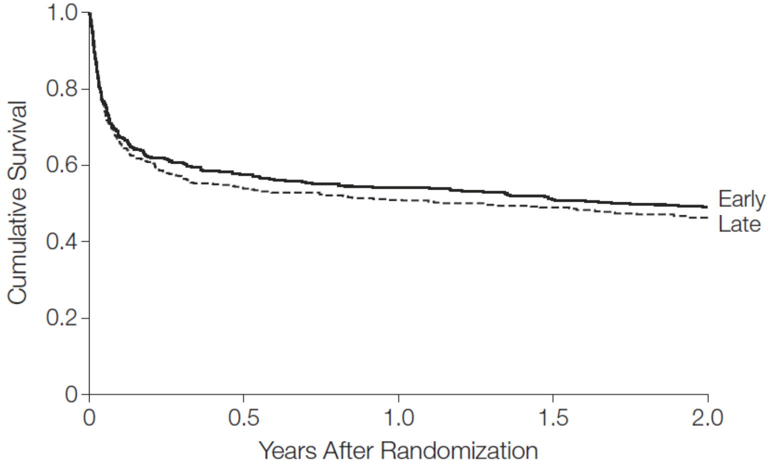
Young, D et al; TracMan Collaborators (2013). JAMA 309:2121–2129.

Effect of Early vs Late Tracheostomy Placement on Survival in Patients Receiving Mechanical Ventilation. The TracMan Randomized Trial

- **2 year mortality:**
  - 51.0% (95% CI, 46.4%-55.6%) in the early
  - 53.7% (95% CI, 49.1%-58.3%) in the late group (*P*=.74)

- **Median critical care unit length of stay** in survivors:
  - 13.0 days in the early
  - 13.1 days in the late group (*P*=.74)

Figure 3. Kaplan-Meier Survival Curve to 2 Years After Randomization



No. at risk					
Early	451	261	244	230	221
Late	448	242	226	217	205

The survival of patients by treatment group for 2 years after randomization (*P* = .45, Cox-Mantel log rank test).

Effect of Early vs Late Tracheostomy Placement on Survival in Patients Receiving Mechanical Ventilation. The TracMan Randomized Trial

Conclusions & Relevance:

- For patients breathing with the aid of mechanical ventilation treated in adult critical care units in the United Kingdom, tracheostomy within 4 days of critical care admission ***was not associated*** with an improvement in 30-day mortality or other important secondary outcomes.

- The ability of clinicians to predict which patients required extended ventilatory support was limited.

Young, D et al; TracMan Collaborators (2013). JAMA 309:2121–2129.

EUROPEAN RESPIRATORY *journal*
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EDITORIAL

Tracheostomy in children: an ancient procedure still under debate

Angelo Barbato, Laura Bottecchia and Deborah Snijders

Optimal timing for tracheostomy in children is controversial, outweighing the risk of the procedure and the expected benefits

Expected benefits:

- reduction in duration of mechanical ventilation
- Reduced stay in the intensive care unit (ICU) and hospital
- decrease in morbidity and mortality

EUROPEAN RESPIRATORY journal
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EDITORIAL

Tracheostomy in children: an ancient procedure still under debate

Angelo Barbato, Laura Bottecchia and Deborah Snijders

Surveys in ventilated adults indicate that tracheostomy should be performed medially at 9–13 days of mechanical ventilation.

In ventilated children, the option of tracheostomy is suggested after 21–28 days of mechanical ventilation.

- Possible explanation for this delay
  - *more rapid resolution of acute respiratory distress syndrome in children compared to adults*.

EUROPEAN RESPIRATORY journal
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EDITORIAL

Tracheostomy in children: an ancient procedure still under debate

Angelo Barbato, Laura Bottecchia and Deborah Snijders

Conclusion:

- Tracheostomy is widely performed in children, despite the advances of noninvasive mechanical ventilation.

- However,
  - multicentered studies with large patient cohorts lacking
  - some aspects of tracheostomy still under debate need to be clarified
    - Eg. whether, when and how to perform tracheostomy, and when to stop it

Timing of Tracheostomy in Critically Ill Patients: A Meta-Analysis

Huibin Huang[1], Ying Li[1], Felinda Ariani[2], Xiaoli Chen[1], Jiandong Lin[1]*

Abstract

Objective: To compare important outcomes between early tracheostomy (ET) and late tracheostomy (LT) or prolonged intubation (PI) for critically ill patients receiving long-term ventilation during their treatment.

Method: We performed computerized searches for relevant articles on PubMed, EMBASE, and the Cochrane register of controlled trials (up to July 2013). We contacted international experts and manufacturers. We included in the study randomized controlled trials (RCTs) that compared ET (performed within 10 days after initiation of laryngeal intubation) and LT (after 10 days of laryngeal intubation) or PI in critically ill adult patients admitted to intensive care units (ICUs). Two investigators evaluated the articles; divergent opinions were resolved by consensus.

Table 1. Summary Characteristics of the Study.

Study/year published	Ref. No.	ICU setting	Surgical approach	ET group	LT/PI group	Outcome pre-state /Jadad score	VAP definition
Young 2013	11	70 adult general and 2 cardiothoracic CCU	PDT/ST	Within 4 days (n = 451)	After 10 days if still indicated (n = 448)	Mortality, length of ICU stay/3	Not reported
Zheng 2012	9	Surgical patients	PDT	Day 3 of MV (n = 58)	Day 15 of MV (n = 61)	Mortality, duration of MV, length of ICU stay, VAP/5	Using the modified CPIS.
Trouillet 2011	13	Postcardiac surgery ICU	PDT	Before 5 days after surgery (n = 109)	15 d after initiation of MV (n = 107)	Mortality, duration of MV, length of ICU stay, VAP/4	Clinical features with positive BAL cultures
Terragni 2010	25	12 ICUs	PDT	After 6–8 days of laryngeal intubation (n = 209)	After 13–15 days of laryngeal intubation (n = 210)	Mortality, duration of MV, length of ICU stay, VAP/4	Using the modified CPIS.
Bolt 2008	12	25 Medical or surgical ICUs	PDT/ST	Within 4 days (n = 61)	Prolonged endotracheal intubation (n = 62)	Mortality, duration of MV, length of ICU stay, VAP/3	Clinical features with positive BAL cultures
Barquist 2006	26	Trauma center	ST	Before day 8 (n = 29)	After day 28 (n = 31)	Mortality, duration of MV, length of ICU stay, VAP/4	CDC criteria
Rumbak 2004	7	3 Medical ICUs	PDT	Within 48 hr (n = 60)	Days 14–16 of MV (n = 60)	Mortality, duration of MV, length of ICU stay, VAP/4	Clinical features with positive BAL cultures
Bouderk 2004	8	Units for head injury patients	PDT	5–6 days after ICU admission (n = 31)	Prolonged endotracheal intubation (n = 31)	Mortality, length of ICU stay/3	CDC criteria
Saffle 2002	24	Burn ICU.	ST	4 days after burn Injury (n = 21)	14 days after burn injury (n = 23)	Mortality, duration of MV, length of ICU stay, VAP/3	CDC criteria

ICU, intensive care unit; MV, mechanical ventilation; VAP, ventilator-associated pneumonia; CPIS, Clinical Pulmonary Infection Score; CDC, Centers for Disease Control and Prevention; ET, early tracheotomy; LT late tracheotomy; PI, prolonged intubation; PDT, percutaneous dilatational tracheostomy; ST, surgery technique; BAL, bronchoalveolar lavage.

doi:10.1371/journal.pone.0092981.t001

Timing of Tracheostomy in Critically Ill Patients: A Meta-Analysis

Huibin Huang[1], Ying Li[1], Felinda Ariani[2], Xiaoli Chen[1], Jiandong Lin[1]*

Results: A meta-analysis was evaluated from nine randomized clinical trials with 2,072 participants. Compared to LT/PI, ET did not significantly reduce short-term mortality [relative risks (RR) = 0.91; 95% confidence intervals (CIs) = 0.81–1.03; p = 0.14] or long-term mortality (RR = 0.90; 95% CI = 0.76–1.08; p = 0.27). Additionally, ET was not associated with a markedly reduced length of ICU stay [weighted mean difference (WMD) = −4.41 days; 95% CI = −13.44–4.63 days; p = 0.34], ventilator-associated pneumonia (VAP) (RR = 0.88; 95% CI = 0.71–1.10; p = 0.27) or duration of mechanical ventilation (MV) (WMD = −2.91 days; 95% CI = −7.21–1.40 days; p = 0.19).

Conclusion: Among the patients requiring prolonged MV, ET showed no significant difference in clinical outcomes compared to that of the LT/PI group. But more rigorously designed and adequately powered RCTs are required to confirm it in future.

Table 1

Characteristics and Results of Randomized Controlled Trials

	ICU Population	Day of Early Placement	Day of Late Placement	Number of patients	Primary endpoint	Benefit
Young 2013[30]	General, Cardiothoracic	≤4	≥10	899	30-day mortality	No
Bösel 2013[13]	Neuro (stroke)	1-3	7-14	60	ICU LOS	No
Zheng 2012[31]	Surgical	3	15	119	Ventilator free days	Yes
Koch 2012[19]	Neuro, neurosurgical, surgical	≤4	≥6	100	Hospital mortality	No
Trouillet 2011[28]	Cardiac surgical	≤5	≥19	216	Ventilator free days	No
Terragni 2010[27]	General	6-8	≥13	419	VAP incidence	No
Blot 2008[10]	Medical, Surgical	≤4	Never/≥14*	123	28-day mortality	No
Barquist 2006[12]	Trauma	≤7	≥29	60	Duration of MV	No
Rumbak 2004[23]	Medical	≤2	14-16	120	Pneumonia	No
Bouderka 2004[14]	Trauma	5-6	Never	62	Duration of MV	Yes
Saffle 2002[24]	Burn	Next OR day	≥14	44	Duration of MV	No
Sugerman 1997[26]	Trauma	3-5	≥10-14	112	ICU LOS	No
Rodriguez 1990[22]	Surgical	≤7	≥8	106	Duration of MV	Yes
Dunham 1984[15]	Trauma	3-4	14	74	Laryngotracheal pathology	No
El-Naggar 1976[16]	General	3	10-11	52	Patient characteristics	No

*Study did not require late tracheostomy, but if placed had to be after day 14.

ICU = intensive care unit; LOS = length of stay; VAP = ventilator-associated pneumonia; MV = mechanical ventilation; OR = operating room;

To Trach or not to Trach: Uncertainty in the Care of the Chronically Critically Ill.

Conclusions:

- Clinicians struggle to accurately predict which patients will require PMV;
  - This may be the major factor impacting the effectiveness of a uniform early tracheostomy protocol for mechanically ventilated patients.

- Based on the available evidence, routine placement of tracheostomy prior to day 10 of mechanical ventilation is not indicated.

Bice T, et al. Seminars in Respiratory Critical Care Medicine. 2015 Dec; 36 (6):851-858

The Child with 'Trach & Vent'

SickKids' LTV Discharge Pathway

SickKids® → Holland Bloorview Rehabilitation Hospital → Home

Tracheostomy and long term ventilation (LTV)

Family Milestones

aboutkidshealth
Trusted answers from The Hospital for Sick Children

SickKids

Prerequisites

Minimum of 2 caregivers

Training ~ 8 weeks

Long-term anticipated uncovered costs – min. $4800 CA/yr

- Home/vehicle modifications
- Community nursing support
- Equipment & supplies
- Hospital/follow up appointments
- Hospitalisation – PICU
- Caregivers - CPR trained
- Emergency kits

Knowledge of routine tracheostomy care & complications

What Home Looks Like!

Courtesy of Dr. Reshma Amin

Challenges

Significant burden for family

Financial

- Loss of income if one parent chooses to stay home
- Start up costs - $2400 CA
- Annual - $4800 CA (over government funding)
- Extra nursing cost not covered, site dependent

Lack of privacy with nurses

Caregiver burnout

Family stress

- Spousal
- sibling

Late(r) Tracheostomy

Careful consideration is key

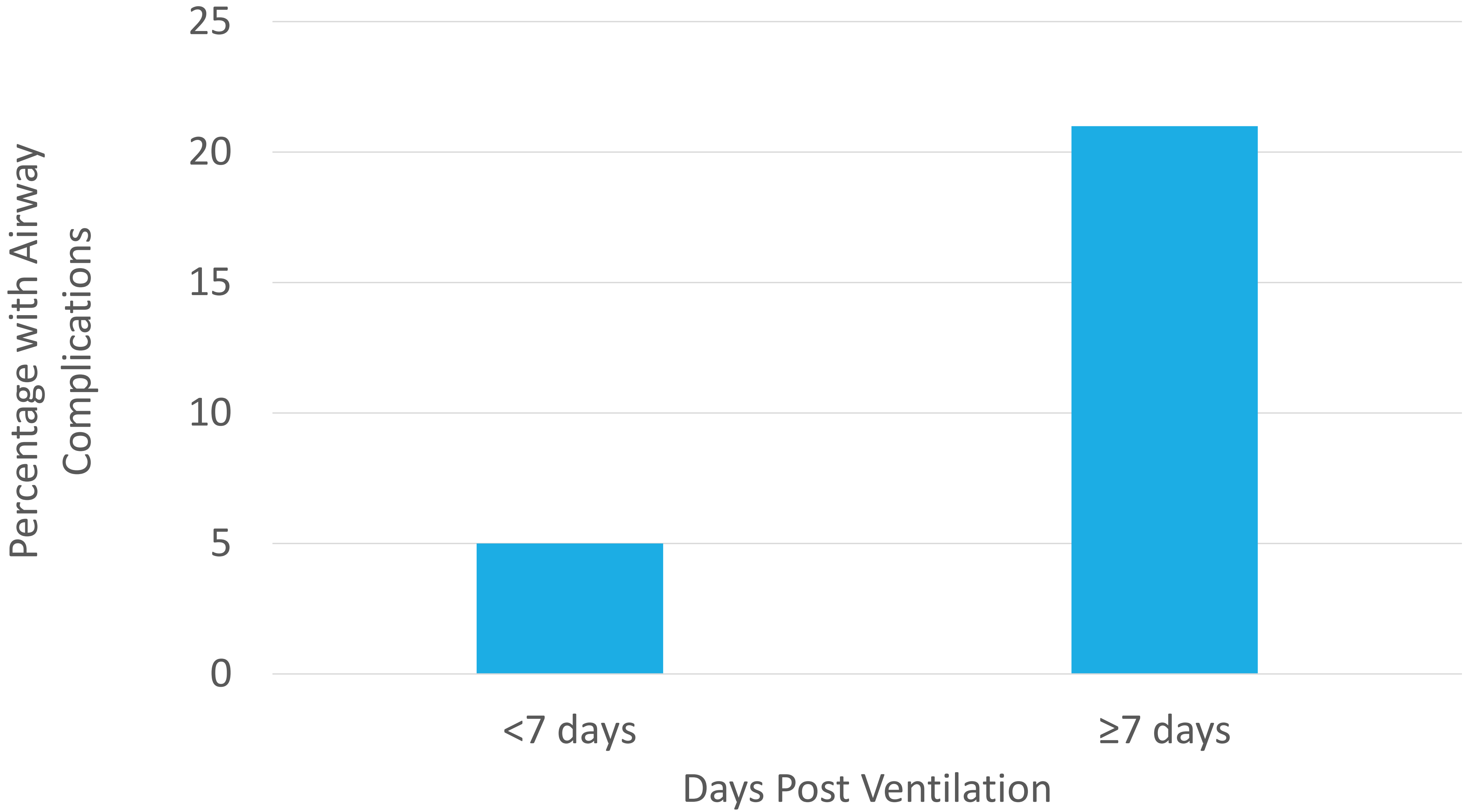
Is it justified?

Informed decision & collaborative effort

Meet the patient’s goals of care

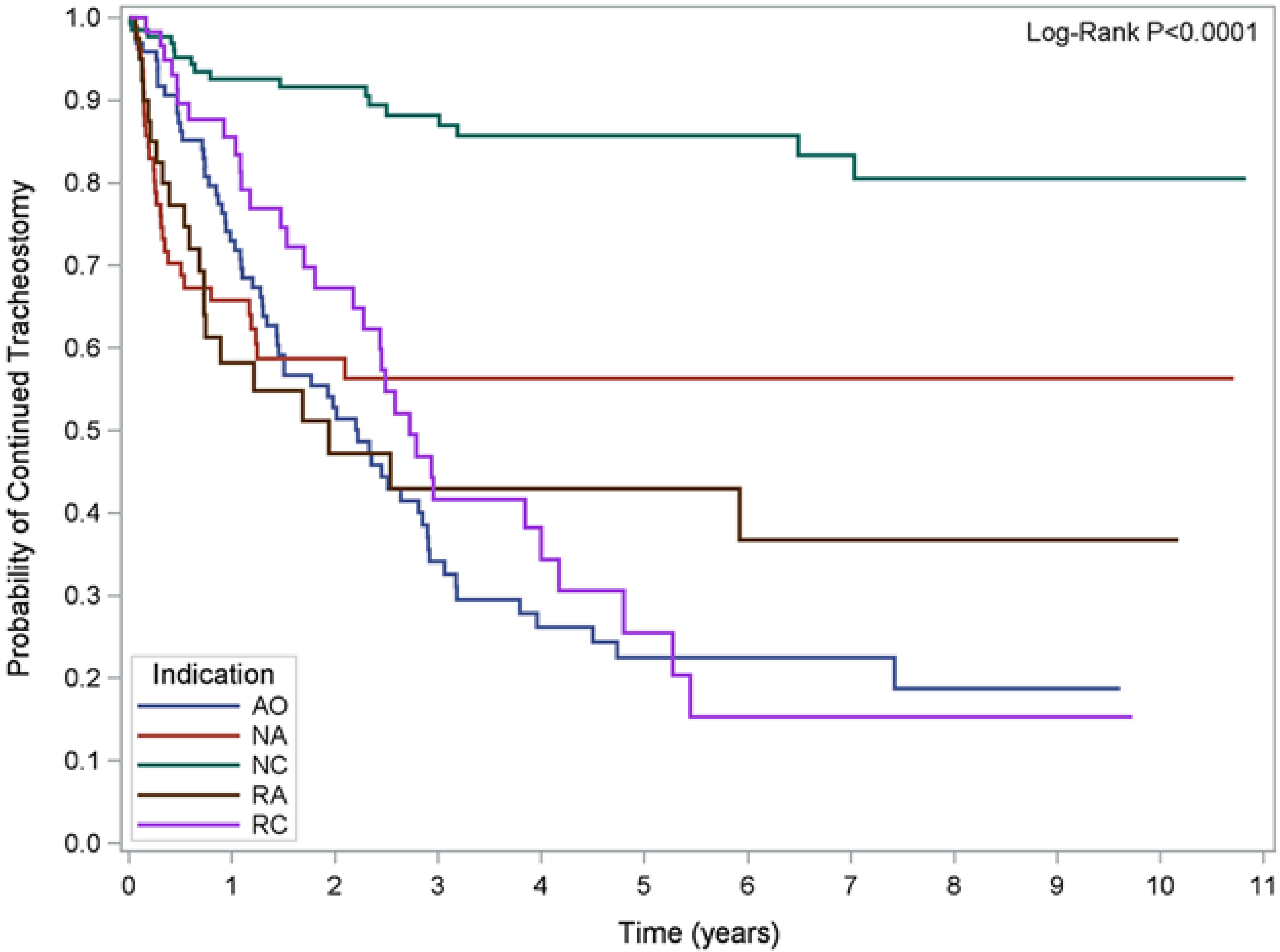
Rebuttal

MICHAEL DERYNCK

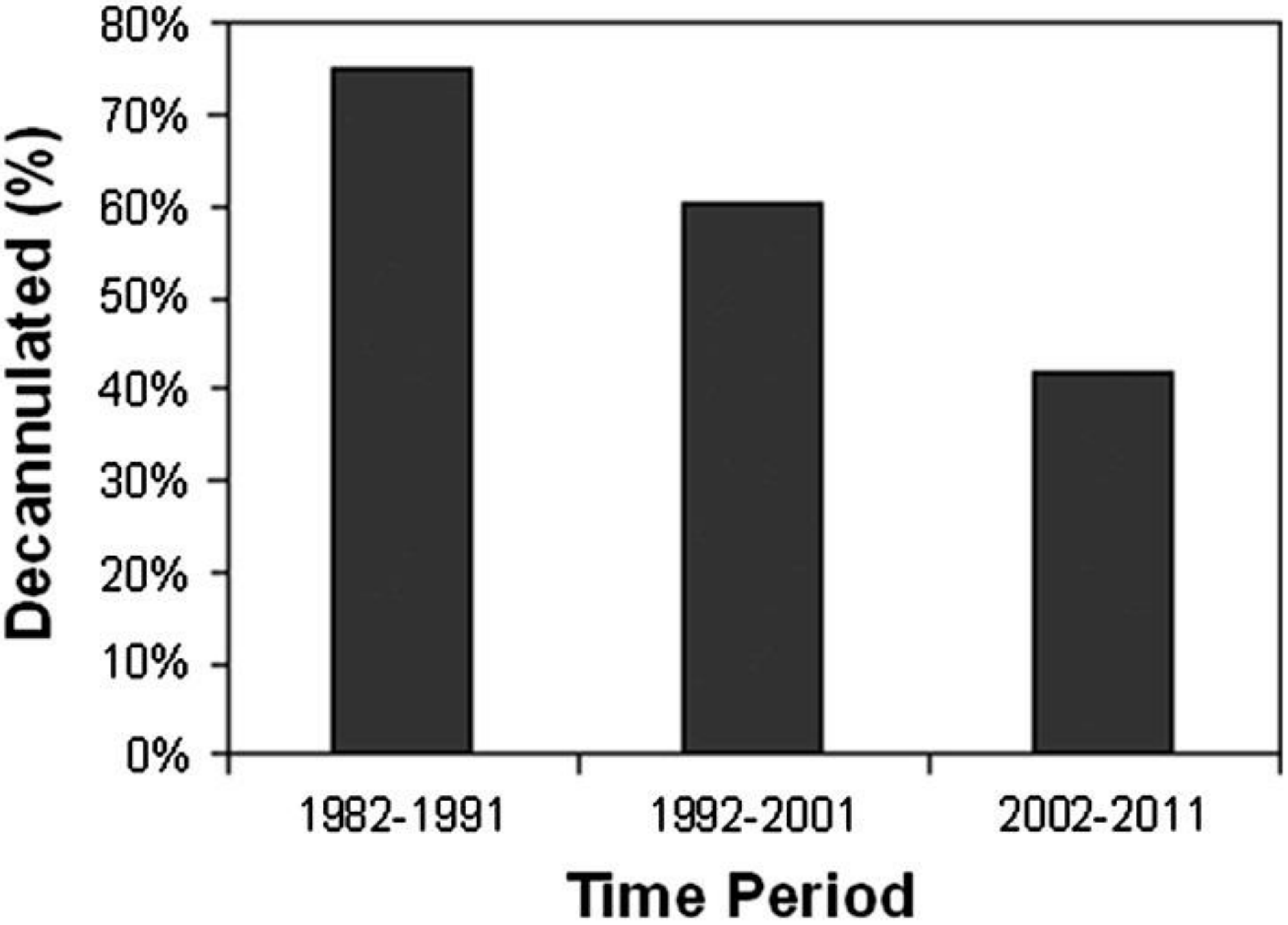


Holscher, C et al. J Pediatr Surg. 2014

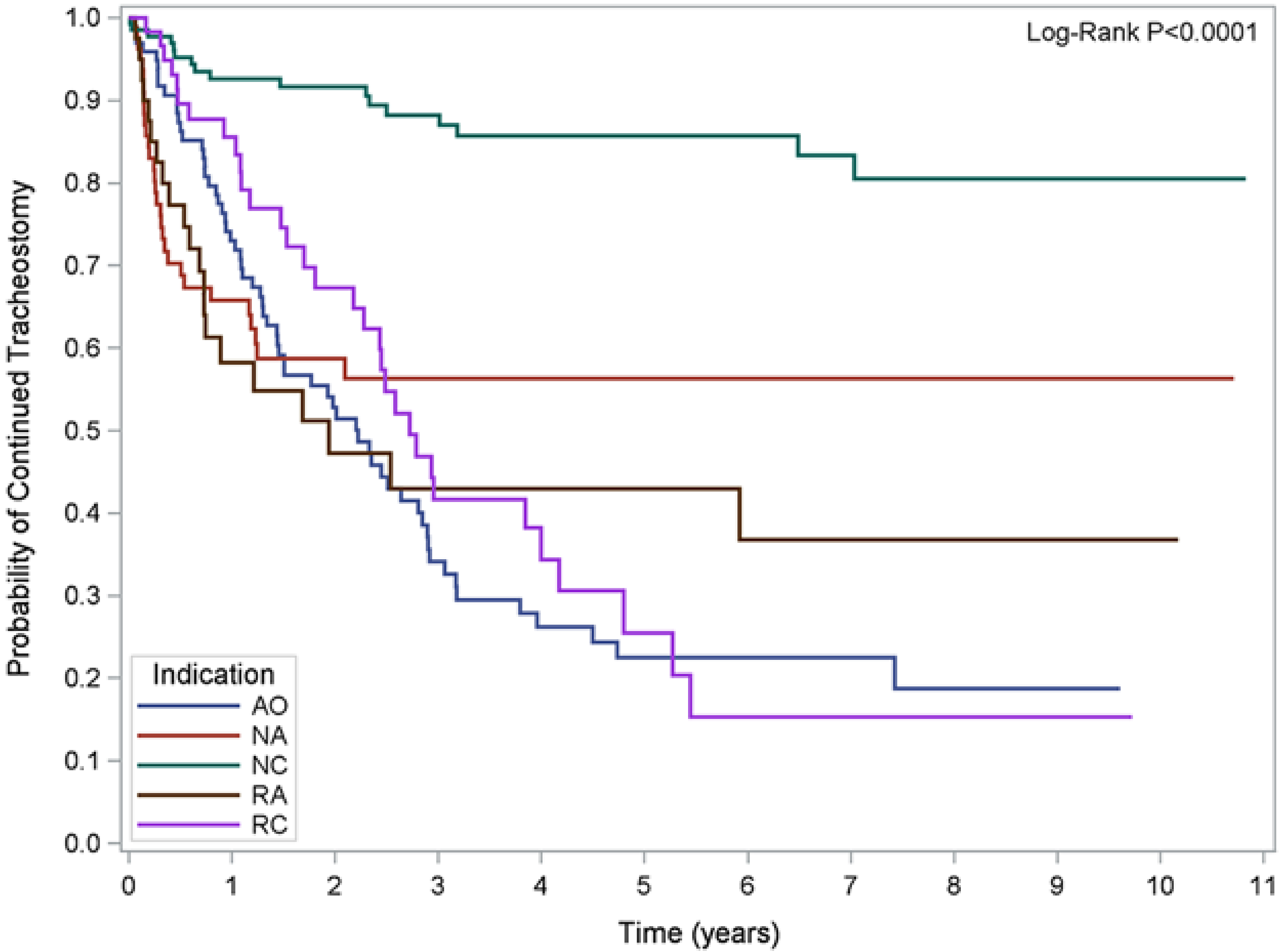
TEMPORARY



McPherson, M et al. Ped Pulm. 2016



Ogilvie, L et al. J Pediatr Surg. 2014



McPherson, M et al. Ped Pulm. 2016

Early tracheostomy

Improvements beyond death
- HAP (adult)
- Ventilator independence
- Sedation (adult)
- QOL

Tracheostomy ≠ forever

Predicted trajectories of major pediatric indications

Rebuttal

CHARMAINE CROOKS-EDWARDS

Recent PICU Case

7 year old male

Complex Medical History –

- Hypomyelination with atrophy of basal ganglia and cerebellum (HABC)
- Hypoventilation – tracheostomy & ventilation
- Seizure disorder
- GDD
- Sialorrhoea
- Severe GERD – GT/GJ, Ostomy

Tracheostomy done Jan 2013 (16 months old) – parental preference

Frequent readmissions to PICU

Immediate Complications	Early Complications	Late Complications
Hemorrhage	Hemorrhage	Tracheal stenosis
Structure damage to trachea	Tube displacement	Granulation tissue
Failure of procedure	Pneumothorax	Tracheomalacia
Aspiration event	Pneumomediastinum	Pneumonia
Air embolism	Subcutaneous emphysema	Aspiration event
Loss of airway	Stomal infection	Tracheoarterial fistula
Death	Stomal ulceration	Tracheoesophageal fistula
Hypoxemia, hypercarbia	Accidental decannulation	Accidental decannulation
	Dysphagia	Dysphagia

The timing of tracheostomy in critically ill patients undergoing mechanical ventilation: systematic review & meta-analysis of RCTS.

Early or late tracheotomy for critically ill ventilated patients

Systematic review of 7 RCT trials (n = 1,044)

No difference in:

- short-term or long-term mortality
- ventilator-associated pneumonia
- duration of mechanical ventilation
- Sedation
- duration of stay in ICU or hospital
- complications

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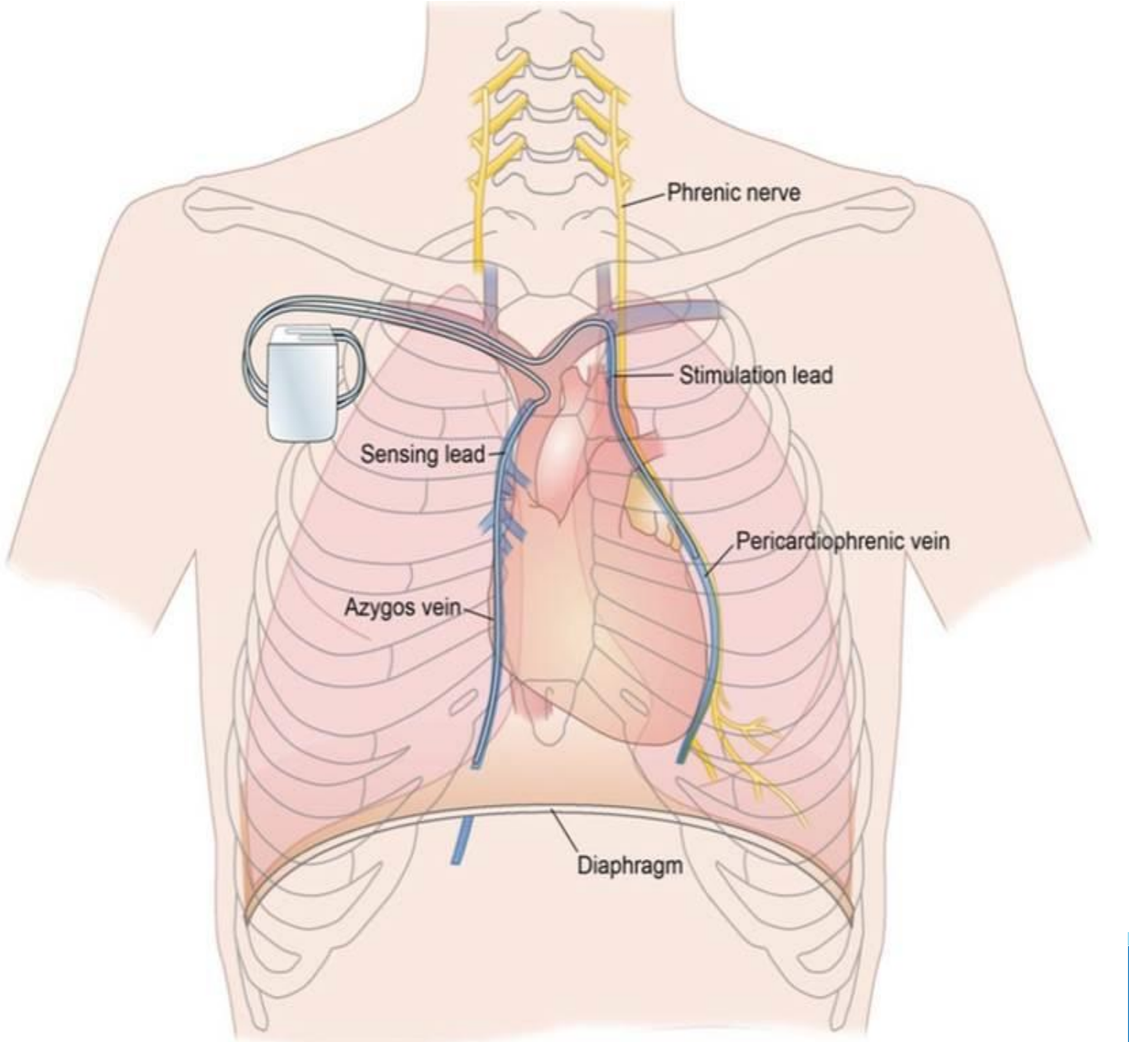
Wang, F et al. 2011. Chest Dec; 140 (6):1456-1465

Medical Advancements

Non-invasive ventilation

- Trilogy
- Heated High Flow Oxygen therapy
- Better fitting masks for BiPAP machines
- Inspiratory and expiratory muscle aids

Diaphragmatic pacing



Recent PICU Case

13 year old Male

- Previously well, athletic
- Severe ARDS, likely 2o Hemophagocytic Lymphohistiocytosis
  - Triggered by Parvovirus & an at risk genetic mutation for 2o HLH.
- VV ECMO with decannulation after 81 days
- Percutaneous Tracheostomy after 1~ month of endotracheal intubation
- Chronic mechanical ventilation weaned to NIV
- Current focus
  - Rehabilitation
  - Nocturnal BiPAP (12/5)
  - Physiotherapy

Summary

Summary

Tracheostomy - life saving

Adequate communication with caregivers/surrogates to allow informed decision making.

Limited available pediatric data re: ideal timing lends itself for further opportunities to evaluate this challenging task.

Difficult to accurately predict duration of mechanical ventilation


WHO?