ARDS & Mechanical Ventilation

Kathleen Vollman
ADVANCING NURSING THROUGH KNOWLEDGE & INNOVATION

Kathleen M. Vollman MSN, RN, CCNS, FCCM, FCNS, FAAN
Clinical Nurse Specialist / Educator / Consultant
ADVANCING NURSING
kvollman@comcast.net
Northville, Michigan
www.vollman.com

The Berlin ARDS Definition

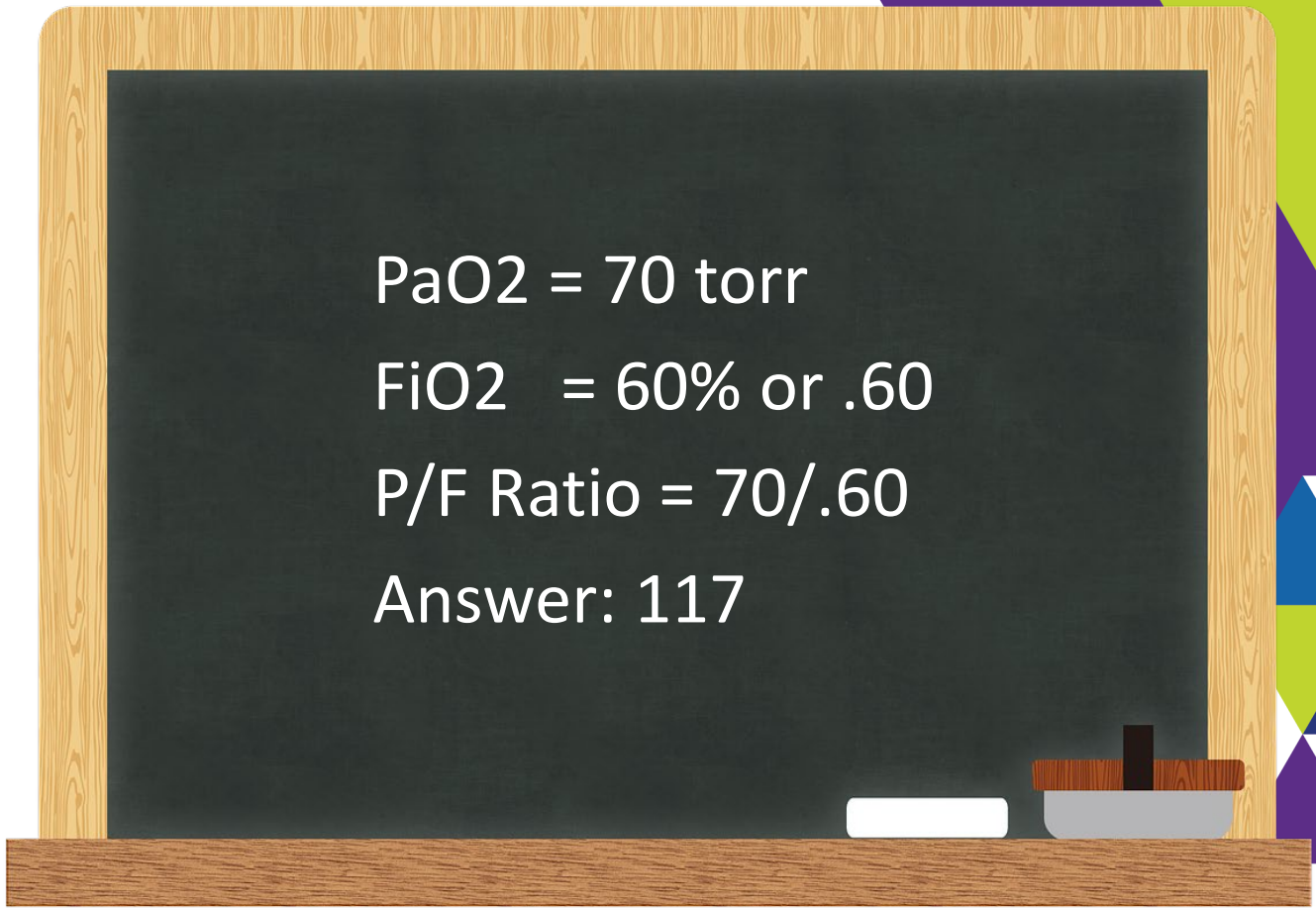
TIMING	Within 1 week of a known clinical insult
CHEST IMAGING (X-RAY OR CAT SCAN)	Bilateral opacities
ORIGIN OF EDEMA	Respiratory failure not fully explained by cardiac failure or fluid overload

	MILD	MODERATE	SEVERE
OXYGENATION	<200 PaO_2/FiO_2 or ≤300 with PEEP/CPAP ≥5 cm H_2O	<100 PaO_2/FiO_2 or ≤200 with PEEP ≥5 cm H_2O	≤100 PaO_2/FiO_2 with PEEP ≥5 cm H_2O
MORTALITY	27% (24% to 30%)	32% (29% to 34%)	45% (42% to 48%)

Ferguson ND, et al. *Intensive Care Med*. 2012;38(10):1573-1582.
Dharia A, et al. *ICU Director*. 2012;3(6):287-292.

PaO_2/FiO_2 Ratio

- User friendly tool
- Crude assessment of the severity of lung injury
- Used in the definition of ARDS
  - Mild
  - Moderate
  - Severe



A New Global Definition of ARDS

ARDS New Global Definition 2023

● new definition criteria	Classification		
	Mild	**Moderate**	**Severe**
Time to instalation	Up to seven days - known risk fator(s)		
Pulmonary edema	Not explained by cardiogenic edema or intravascular volume overload		
Radiologic features	Bilateral infiltrates on chest X-ray or CT or lung ultrasound (by a trained professional) (not explained by nodules, pleural effusion or atelectasis)		
Hypoxemia PaO_2/FIO_2**	201-300 with NIV/CPAP PEEP ≥ 5* **or HFNO > 30l/min**	101 - 200 com PEEP ≥ 5	≤ 100 com PEEP ≥ 5
Hypoxemia SpO_2/FIO_2	**≤ 315 with SpO_2 ≤ 97%**		

Am J Respir Crit Care Med 2023;207:A6229

Pathophysiologic Characteristics in ARDS

- A permeability defect described as a diffuse, non-uniform injury to the alveolar epithelium and alveolar capillary membrane (mediator/biotrauma & ventilator induced)
- Ventilator induced lung injury: overdistenison injury caused by higher tidal volumes and higher transpulmonary pressures. This may induce cytokine release
- Direct injury to pulmonary circulation (mediator/biotrauma & ventilator induced)
- Defect in the body's ability to transport and utilize O_2 at tissue level

Blondonnet R, e tal. Disease Markers, 2016; open access
Manimala R, et al. Current Respiratory Medicine Reviews, 2015;11(3):231-235
Walkey AJ, et al. AnnalsATS, 2017;14(Supp 4): s271-s279

The Eight P's of ARDS Treatment

- PREVENTION
- **PEEP**
- PUMP
- PIPES
- PARALYSIS
- POSITION
- PROTEIN
- PROTOCOL

PEEP

POSITIVE END EXPERIATORY PRESSURE

Indications for Mechanical Ventilation

- Airway compromise due to disease
- Hypoventilation can result from impaired drive, pump failure, or gas exchange difficulties
  - Respiratory muscle weakness (such as muscular dystrophy and myositis)
  - Peripheral nervous system defects (such as Guillain-Barré syndrome or myasthenic crisis)
  - Restrictive ventilatory defects (such as chest wall trauma or disease or massive pneumothorax or effusion)
- Hypoxemic respiratory failure
- Increase ventilation demand—sepsis, severe metabolic dysfunction

Common Modes of Ventilation

- Volume-limited assist control (VAC) ventilation
- Pressure-limited assist control (PAC) ventilation
- Synchronized intermittent mandatory ventilation (SIMV) with pressure support ventilation (PSV)

Setting up the Vent

- Tidal volume (V_T): The tidal volume is usually determined based on ideal or predicted body weight (PBW) rather than actual weight. In conditions such as ARDS that require a protective lung strategy, the V_T is set at a low range of 4 to 8 mL/kg PBW.
- Respiratory rate (RR): The respiratory rate is typically between 12 and 16 breaths per minute. A higher respiratory rate (up to 35 breaths per minute) may be selected to achieve sufficient minute ventilation, especially during a protective lung strategy in ARDS to prevent severe hypercapnia or counteract severe acidosis.
- Inspiratory flow rate (IFR): The inspiratory flow rate is usually set between 40 and 60 L/min to achieve an inspiratory and expiratory ratio of 1:2 or 1:3

Setting up the Vent

- Fraction of inspired oxygen (FiO_2): FiO_2 should be adjusted to the minimum level necessary to maintain a pulse oximetry (SpO_2) reading of 90% to 96%. Avoiding hyperoxemia is crucial, as studies have demonstrated an increase in mortality among critically ill patients with excessive oxygen levels.
- Positive end-expiratory pressure (PEEP): PEEP increases the functional residual capacity and prevents the collapse of alveoli, thus reducing atelectrauma.
- Trigger sensitivity: Triggers can be categorized into 2 types—flow trigger and pressure trigger.
  - Pressure triggers are typically set at -2 cm H_2O but should be avoided if auto-PEEP is suspected. I
  - In such cases, flow triggers should be used and set at a threshold of 2 L/min

Strategies for Ventilating the ARDS Lung: Protect From Injury

- Oxygen exposure
- Pressure (Barotrauma)
- Volume (Volutrauma & Biotrauma)
- Shear forces (Reopening & closing of alveoli) (Atelectrauma & Biotrauma)

ATS & SCCM Guidelines for Mechanical Ventilation of ARDS Patients

- Strong recommendation for:
  - Using lower tidal volumes (4-8ml/kg PBW) & lower inspiratory pressures (plateau pressures < 30 cm H2O
  - Severe ARDS prone positioning for > 12 h/d
  - Against the routine use of HFOV
- Conditional recommendation
  - Higher PEEP's
  - Recruitment maneuvers

Additional evidence needed for ECMO

Amer J of Respir & Crit Care Med, 2017:195(9):1253-1263

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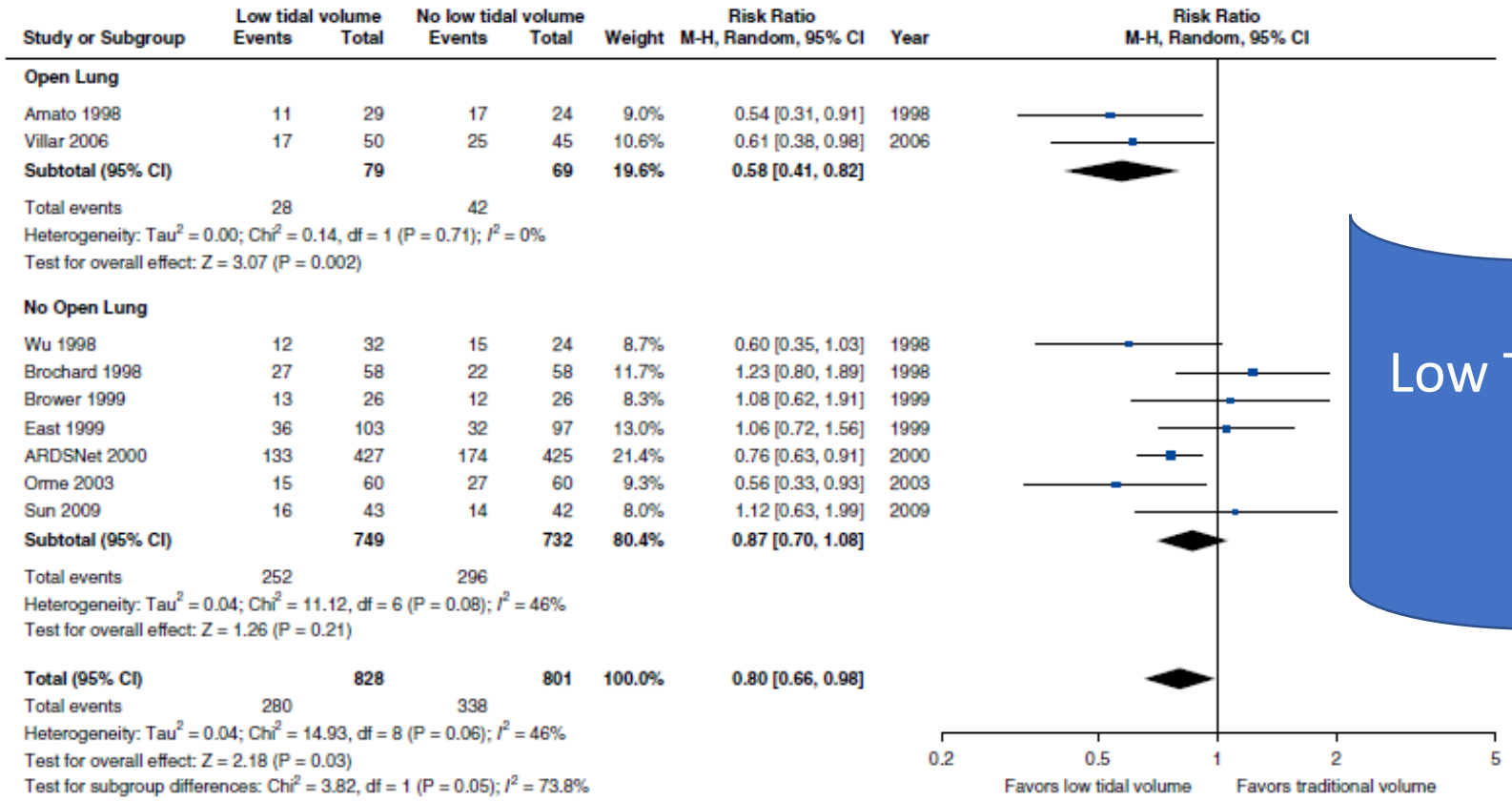
2023 ESICM Practice Guidelines

- For intubated patients with ARDS
  - Use low tidal volume ventilation (ie, 4-8 mL/kg predicted body weight) vs larger tidal volumes to reduce mortality (strong recommendation; high level of evidence)
  - Do not use prolonged high-pressure recruitment maneuvers (strong recommendation; moderate level of evidence) or brief high-pressure recruitment maneuvers (weak recommendation; high level of evidence)
- For intubated patients with moderate to severe ARDS
  - Use prone position to reduce mortality (strong recommendation; high level of evidence)
  - Do not routinely use continuous infusions of neuromuscular blockade to reduce mortality (strong recommendation; moderate level of evidence)
  - Refer patients who meet criteria for ECMO (extracorporeal membrane oxygenation) to ECMO centers (strong recommendation; moderate evidence)

Grasselli G, et al ESICM guidelines on acute respiratory distress syndrome: definition, phenotyping and respiratory support strategies. *Intensive Care Med*. Published online June 16, 2023.doi:10.1007/s00134-023-07050-7

Low Tidal Volume

- 7 RCT's
- 1481 patients



Study or Subgroup	Low tidal volume Events	Total	No low tidal volume Events	Total	Weight	Risk Ratio M-H, Random, 95% CI	Year
Open Lung							
Amato 1998	11	29	17	24	9.0%	0.54 [0.31, 0.91]	1998
Villar 2006	17	50	25	45	10.6%	0.61 [0.38, 0.98]	2006
Subtotal (95% CI)		**79**		**69**	**19.6%**	**0.58 [0.41, 0.82]**	
Total events	28		42				
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.14$, df = 1 (P = 0.71); $I^2 = 0\%$							
Test for overall effect: Z = 3.07 (P = 0.002)							
No Open Lung							
Wu 1998	12	32	15	24	8.7%	0.60 [0.35, 1.03]	1998
Brochard 1998	27	58	22	58	11.7%	1.23 [0.80, 1.89]	1998
Brower 1999	13	26	12	26	8.3%	1.08 [0.62, 1.91]	1999
East 1999	36	103	32	97	13.0%	1.06 [0.72, 1.56]	1999
ARDSNet 2000	133	427	174	425	21.4%	0.76 [0.63, 0.91]	2000
Orme 2003	15	60	27	60	9.3%	0.56 [0.33, 0.93]	2003
Sun 2009	16	43	14	42	8.0%	1.12 [0.63, 1.99]	2009
Subtotal (95% CI)		**749**		**732**	**80.4%**	**0.87 [0.70, 1.08]**	
Total events	252		296				
Heterogeneity: $Tau^2 = 0.04$; $Chi^2 = 11.12$, df = 6 (P = 0.08); $I^2 = 46\%$							
Test for overall effect: Z = 1.26 (P = 0.21)							
Total (95% CI)		**828**		**801**	**100.0%**	**0.80 [0.66, 0.98]**	
Total events	280		338				
Heterogeneity: $Tau^2 = 0.04$; $Chi^2 = 14.93$, df = 8 (P = 0.06); $I^2 = 46\%$							
Test for overall effect: Z = 2.18 (P = 0.03)							
Test for subgroup differences: $Chi^2 = 3.82$, df = 1 (P = 0.05); $I^2 = 73.8\%$							

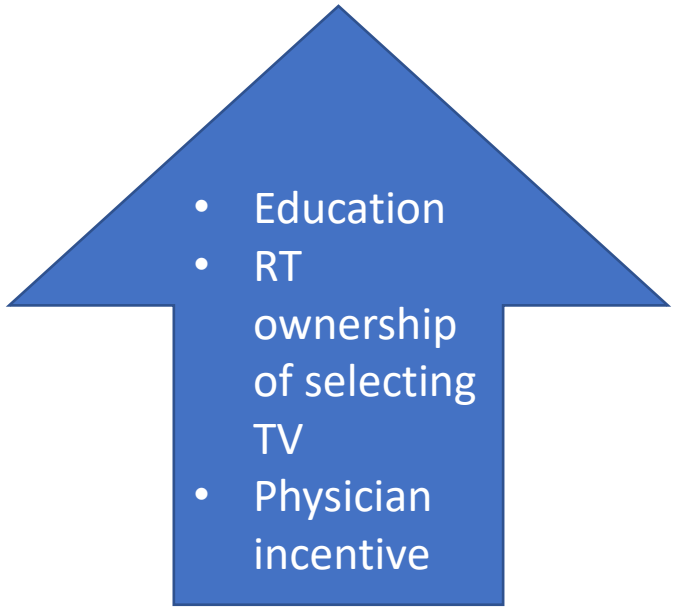
Low TV achieved in < 2/3 of ARDS patients

Bellaini G, et al. JAMA, 2016;315(8):788-800

Walkey AJ, et al Ann Am Thorac Soc. 2017 Oct;14(Supplement_4):S271-S279.

Improving Delivery of Low Tidal Volume

- QI project-4 PDSA cycles
- 10 ICU's, 3 Hospitals
- Initial compliance rate: 40%-60%



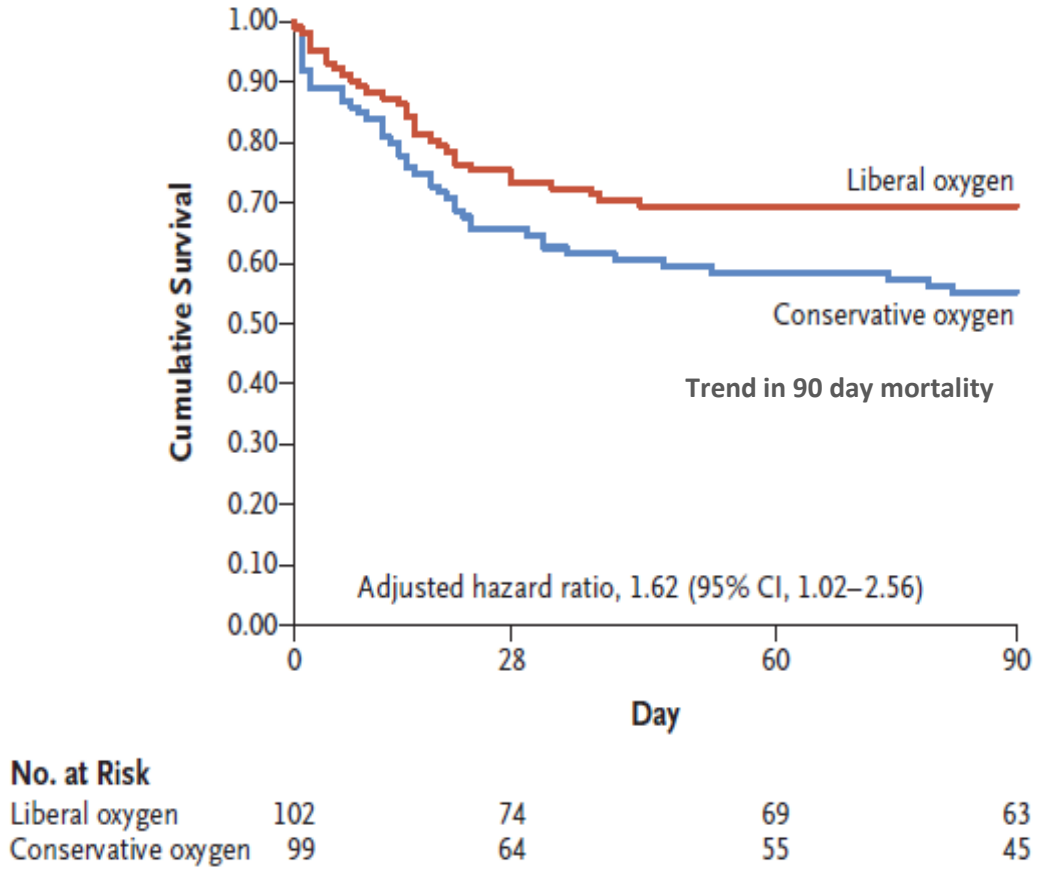
91%-96%

Donadee C. BMJ Open Quality, 2022;11:e001343

Liberal vs. Conservative O2 therapy in ARDS

- RCT-13 ICU's, 205 patients
- Intubated/Ventilated with ARDS < 12hrs
- Randomized:
  - Conservative O2: 55 -70 mmhg
  - Liberal O2: 90-105mmhg
- Targets maintained for first 7days or extubation

Mesenteric ischemia in conservative O2 group



Barrot J, et al. N Engl J Med. 2020;382:999-1008

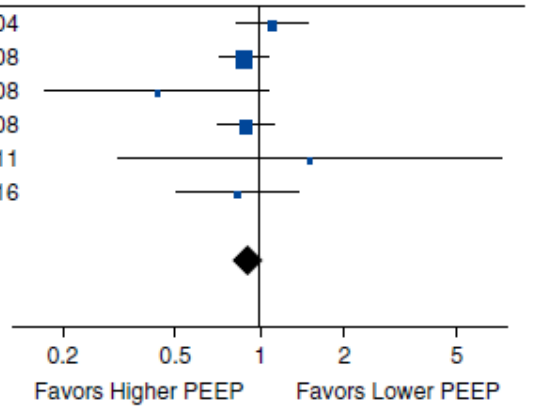
EBR & Meta-analysis: High Peep vs. Low PEEP

- 8 trials, 2,728 patients
- Mean PEEP in higher 15.1 (±3.6 cm)
- Mean PEEP in lower 9.1 (± 2.7cm)
- No difference in mortality, barotrauma, new organ failure or VFD's

	High		Low			Risk Ratio		Risk Ratio
Study or Subgroup	Mortality Events	Total Patients	Mortality Events	Total Patients	Weight	M-H, Random, 95% CI	Year	M-H, Random, 95% CI
Brower *et al.*, 2004	76	276	68	273	19.2%	1.11 [0.83, 1.46]	2004	
Meade *et al.*, 2008	135	475	164	508	40.8%	0.88 [0.73, 1.06]	2008	
Talmor *et al.*, 2008	5	30	12	31	1.9%	0.43 [0.17, 1.07]	2008	
Mercat *et al.*, 2008	107	385	119	382	31.1%	0.89 [0.72, 1.11]	2008	
Hodgson *et al.*, 2011	3	10	2	10	0.6%	1.50 [0.32, 7.14]	2011	
Kacmarek *et al.*, 2016	22	99	27	101	6.4%	0.83 [0.51, 1.36]	2016	
Total (95% CI)		**1275**		**1305**	**100.0%**	**0.91 [0.80, 1.03]**		
Total events	348		392					

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 5.09$, df = 5 (P = 0.41); $I^2 = 2\%$

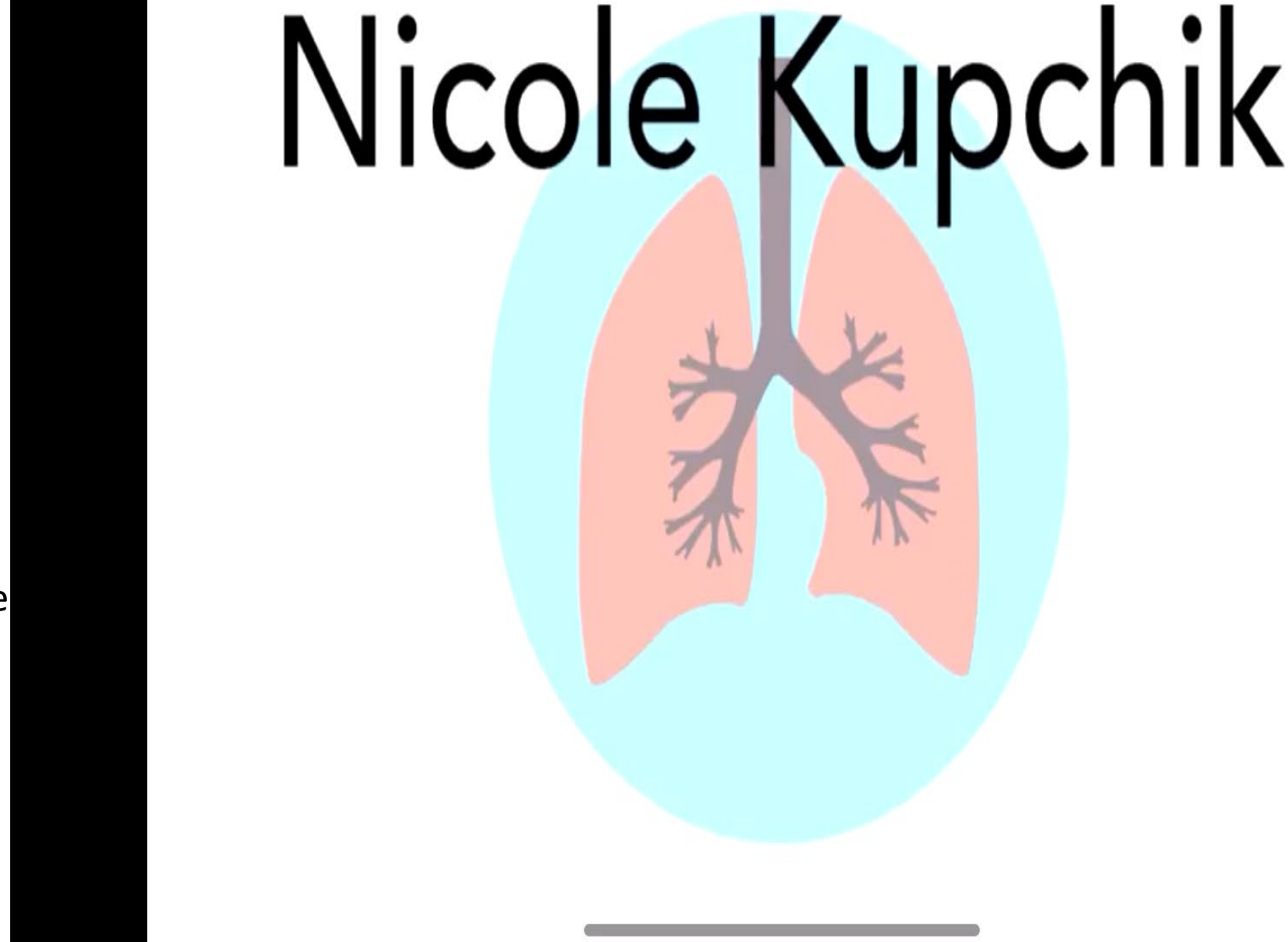
Test for overall effect: Z = 1.46 (P = 0.14)



Walkey AJ, et al. AnnalsATS, 2017;14(Supp 4):s297-s303

How do you know what PEEP to start with post intubation?

- Gattinoni Method
- ARDSnet PEEP/FiO_2 table

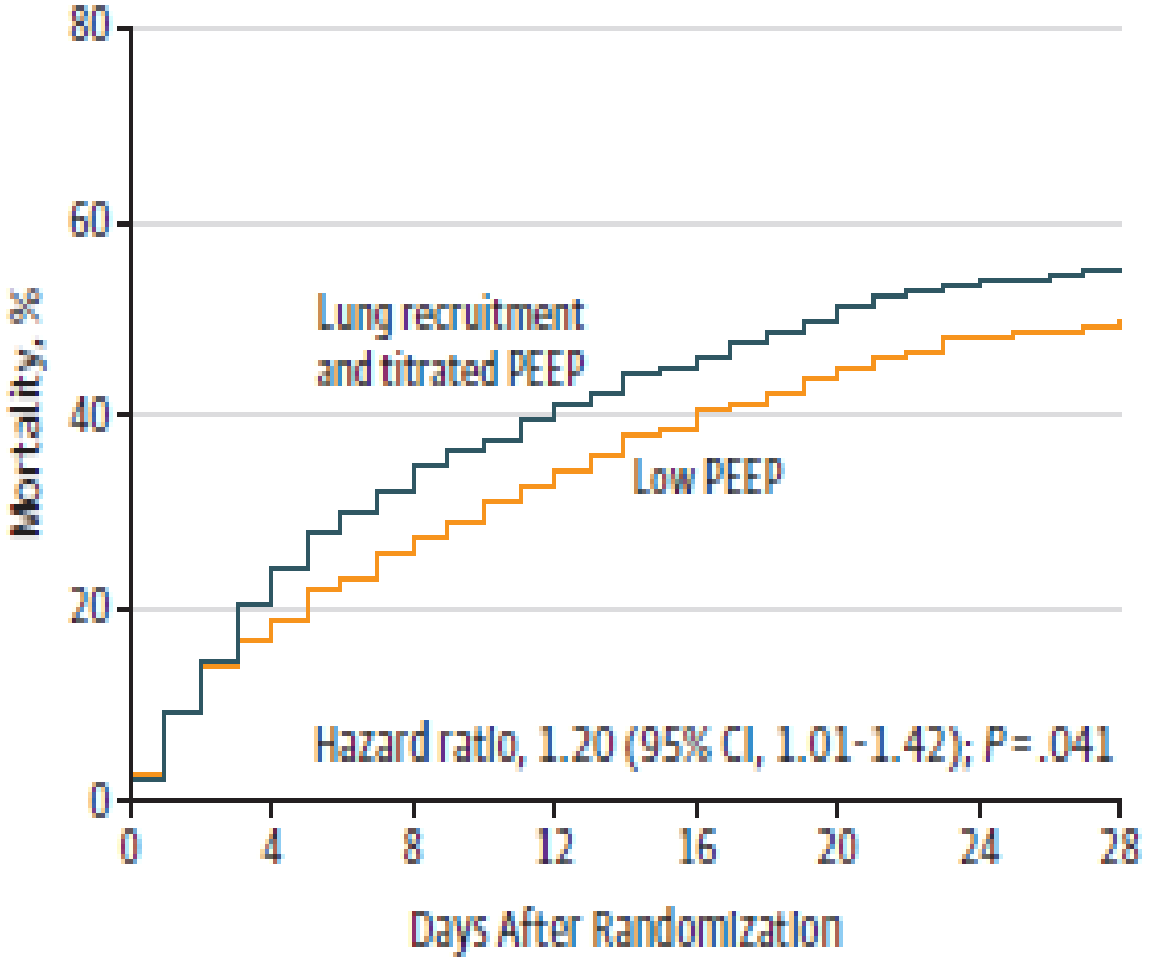


Video used with permission

Titrating PEEP—No difference seen between using Esophageal pressure guided strategy versus the PEEP/FIO2 strategy (Beitler JR, et al. JAMA, 2019;321:646-857

Effect of Lung Recruitment & Titrated PEEP vs Low PEEP on Mortality (ART Trial)

- Multi-center RCT, 120 ICU's, 9 countries, 1010 patients
- Maneuver: RM with incremental PEEP titration, then PEEP set at 23cm and ↓ by 3cm till 11cm based on compliance.
- Results
  - Small # didn't received RM due to hypotension
  - Higher # with barotrauma in RM group
  - PEEP diff was 3-4 cm



Cavalcanti AB, et al. JAMA, 2017;318(14):13351345

PHARLAP:
An Open Lung Strategy including Permissive Hypercapnia, Alveolar Recruitment and Low Airway Pressure in ARDS patients

- A Multi-center RCT in 5 countries/Phase II trial
- Objective: Determine whether maximal lung recruitment strategies reduce VFD versus Low V_t and moderate PEEP
- Enrollment stopped after publication of ART trial

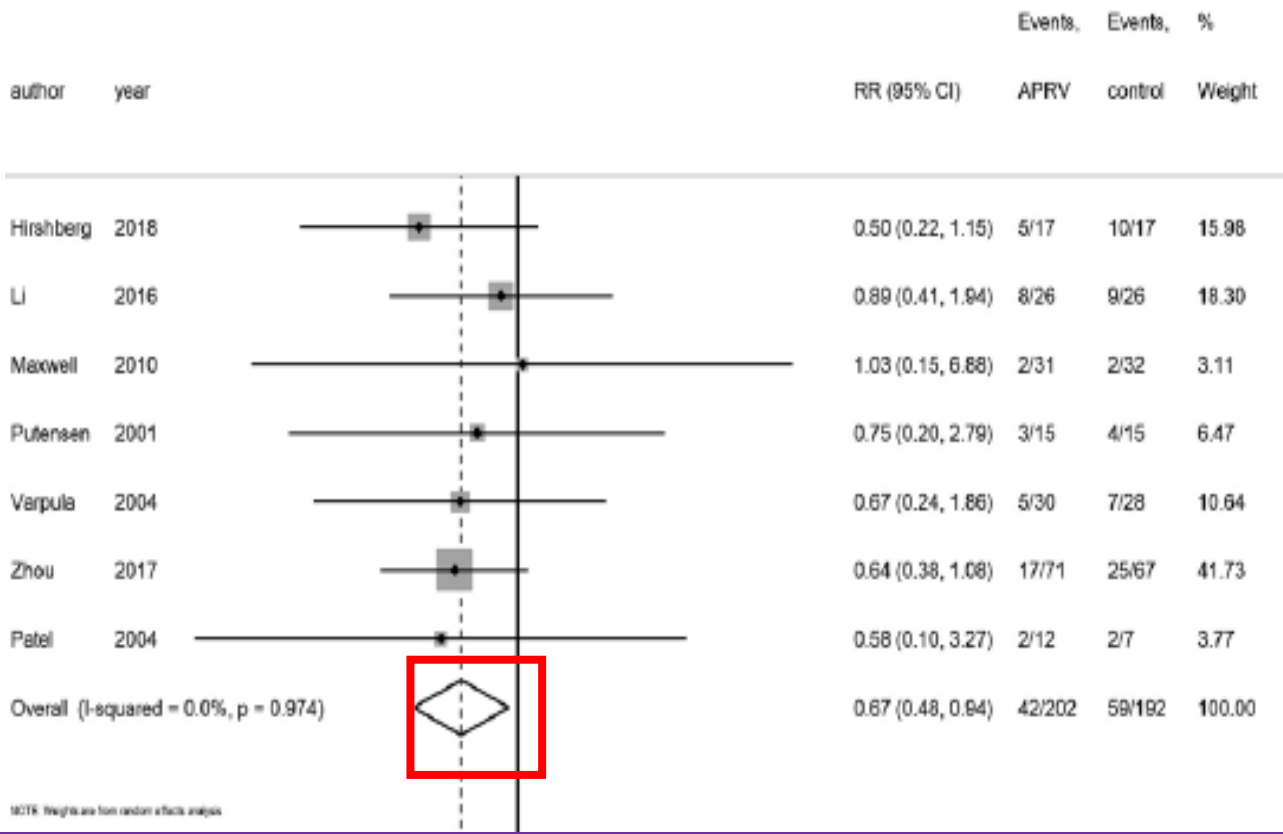
Hodgson CL, et al. Am J Respir Crit Care Med. 2019 Dec 1;200(11):1363-1372.

Adjunctive Strategies

- APRV
- HFOV
- ECMO
- $ECCO_2$ (experimental)
  - The strategy of altar protective lung ventilation with extracorporeal CO2 removal for new onset moderate to severe ARDS (SUPERNOVA) trial
  - Protective ventilation with veno-venous lung assist in respiratory failure (REST) trial

APRV:
Airway Pressure Release Ventilation vs any Ventilator Mode

- 7 RCT's, 412 patients
- Mean measured TV in APRV group: 7.47 ml/kg, vs. 7.45 ml/kg
- Improvement in day 3 PaO2/FiO2 ratio
- No difference in:
  - Initial rescue treatments
    - inhaled pulmonary vasodilators
    - prone positioning
    - ECMO
- Barotrauma only reported in three studies (no difference)

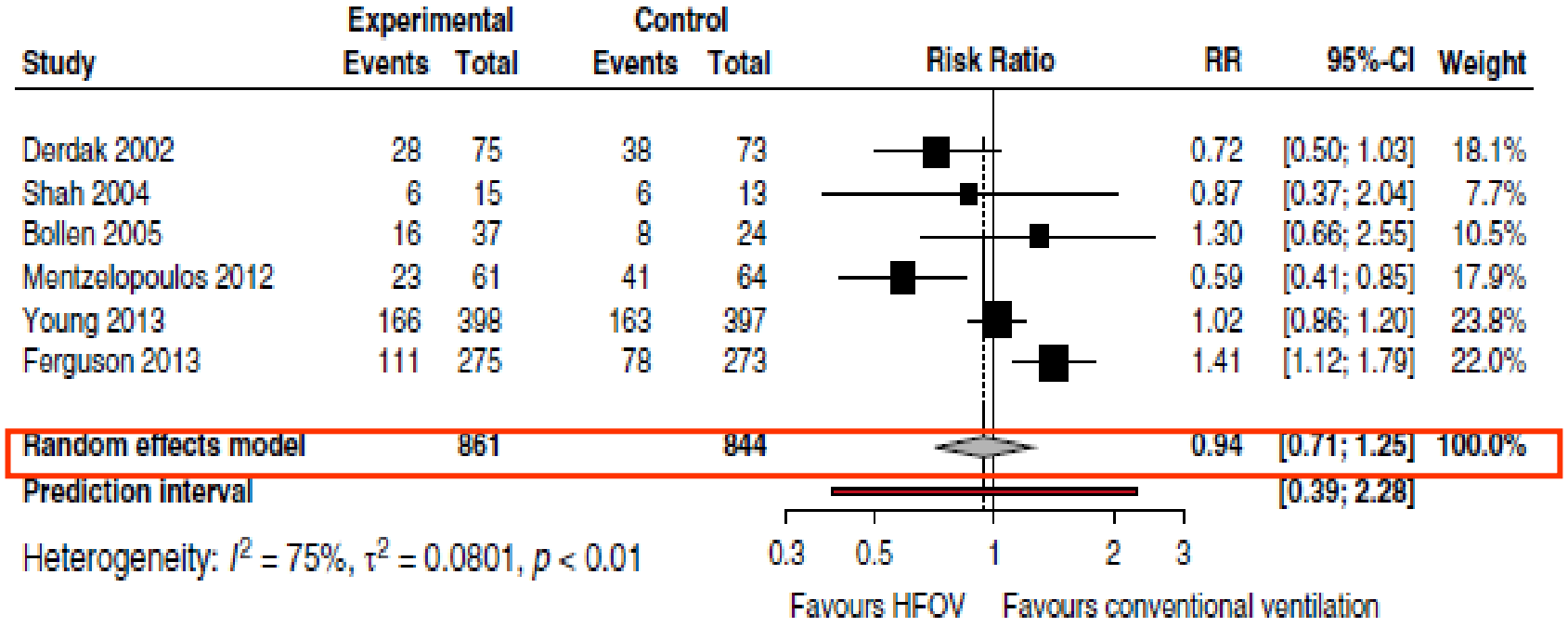


Needed a larger sample to prevent false positive in primary outcomes (614 patients)

Lim J, et al. Crit Care Med. 2019 Dec;47(12):1794-1799.

High Frequency Oscillation: EBR & Meta-analysis

- Six trials with 1715 patients
- No difference in barotrauma rates



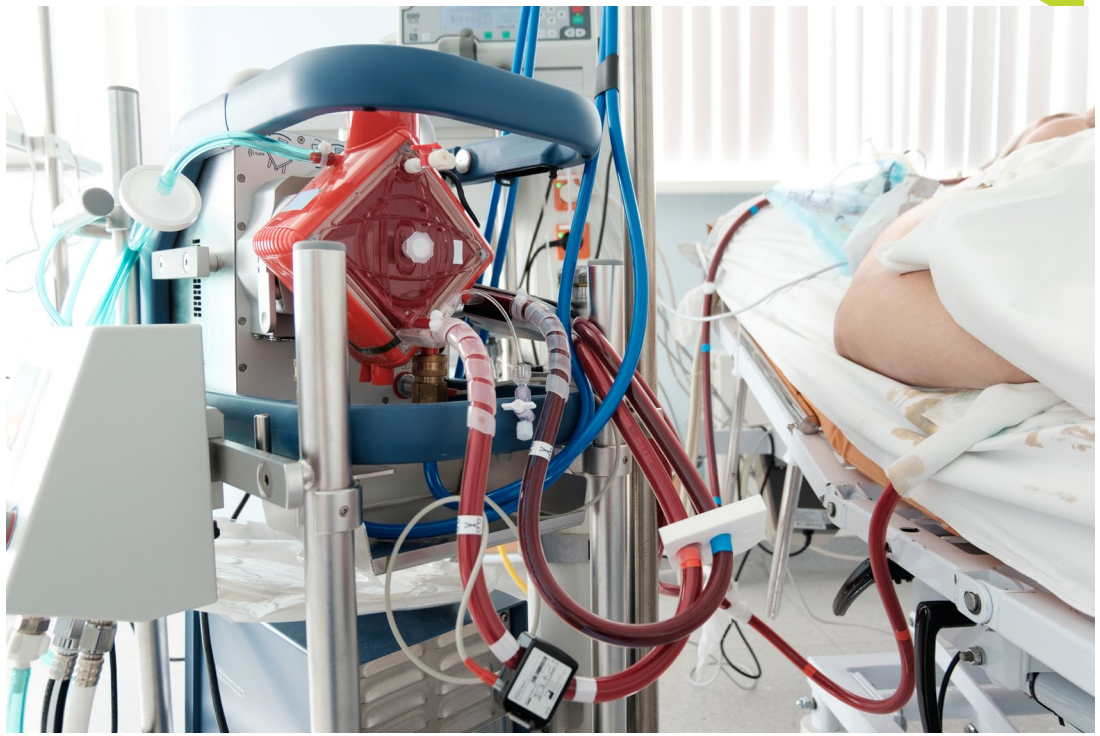
In an individual patient meta-analysis, those with ARDS with P/F ratios < 65mmhg may see a benefit.

Meade MO, et al. AJRCCM,2017;196(6):727-733

Goligher EC, et al. AnnalsATS, 2017;14(suppl 4):s289-s296

EOLIA Trial

- Multicenter, International, RCT
- Method: Compared early VV ECMO or continued conventional ventilator therapy and measure 60-day mortality in patients with severe forms of ARDS
- Cross over to ECMO was possible for conventional group who had refractory hypoxemia
- Results:
  - Mortality: 35% in ECMO versus 46% in control ($p < 0.09$)
  - Crossover to ECMO avg 6.5 days-28% of control / Mortality 57%



Purchased Shutterstock image

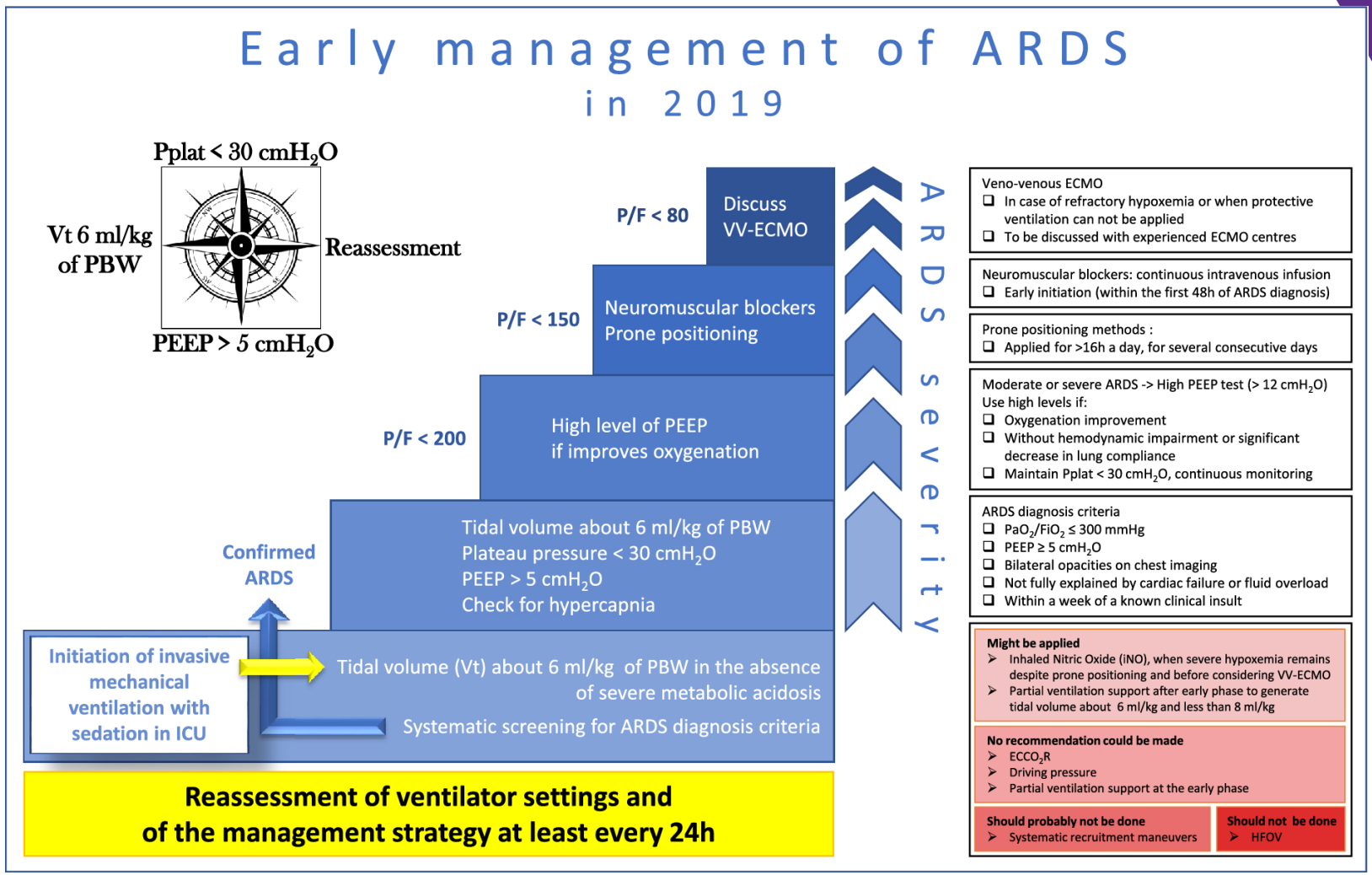
Combes A, et al. New Engl J of Med. 2018;378(21):1965-75

Discoveries with COVID

- Candidacy of Patients
  - Previous scoring tools were no longer accurate
  - Younger patients (<50 yrs) single organ dysfunction had best outcomes
- Shorten the interval from intubation to cannulation
  - Less than 3 days of MV, P/F ratio <70 mmHg
- Adjunctive therapies
  - Monoclonal antibodies, cytoreductive techniques
- Early Extubation
  - Allows for Physical Therapy, Ambulation, decreases resources, Nutrition

Slide courtesy of Lisa Soltis

Sample ARDS Treatment Algorithm



Papazian, L., Formal guidelines: management of acute respiratory distress syndrome. *Ann. Intensive Care* **9,** 69 (2019) Springer Open Journal

Evaluation and Certificate

Survey
link: https://georgetown.az1.qualtrics.com/jfe/form/SV_54mXUy2KAvxGup0

A downloadable certificate of attendance is available at the end of the survey.

PIPES & PUMP

Measures to Improve Oxygen Delivery

Measures to Improve O_2 Delivery

- Fluid Management
  - Balanced fluids vs. Saline
  - Dry vs. Wet

Balanced Fluids vs .9 % Normal Saline

HEMODYNAMIC MANAGEMENT

Fluid Management

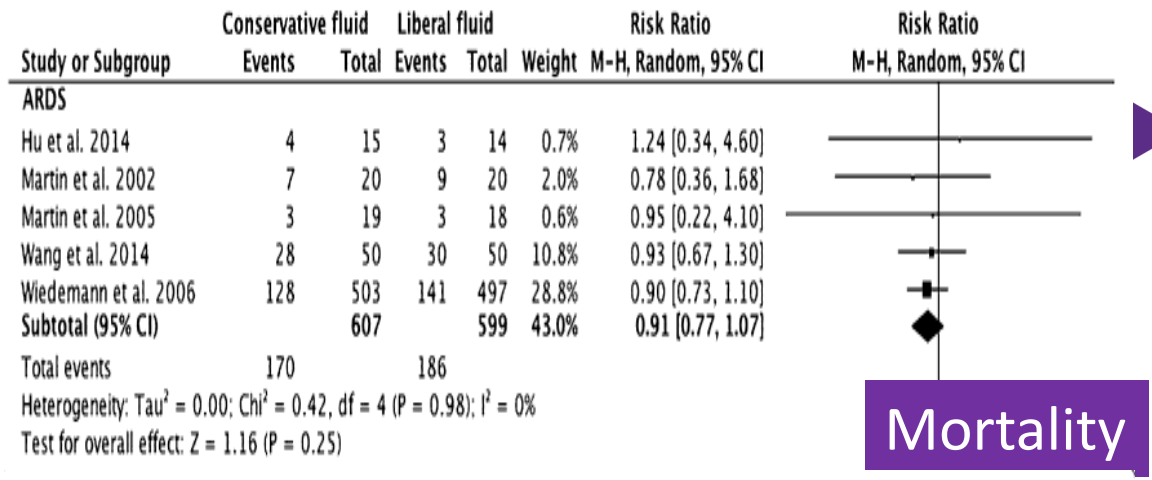
Recommendations
32. For adults with sepsis or septic shock, we **recommend** using crystalloids as first-line fluid for resuscitation. *Strong recommendation, moderate quality of evidence.*
33. For adults with sepsis or septic shock, we **suggest** using balanced crystalloids instead of normal saline for resuscitation. *Weak recommendation, low quality of evidence.*
34. For adults with sepsis or septic shock, we **suggest** using albumin in patients who received large volumes of crystalloids over using crystalloids alone. *Weak recommendation, moderate quality of evidence.*
35. For adults with sepsis or septic shock, we **recommend against** using starches for resuscitation. *Strong recommendation, high quality of evidence.*
36. For adults with sepsis and septic shock, we **suggest against** using gelatin for resuscitation. *Weak recommendation, moderate quality.*

With a high probability, the average effect of using balance fluids is to reduce mortality

Surviving Sepsis Campaign: International Guidelines for the Management of Sepsis and Septic Shock 2021. Evans Hammond NE, et al. Evidence. 2022;1(2):EVIDoa2100010.,

Conservative/ Deresuscitation vs. Liberal Fluid For ARDS Following Critical Phase

- 11 RCT's
- 2051 patients
- Results:
  - No difference in mortality
  - ↑ VFD 1.82 days
  - ↓ LOS 1.9 days

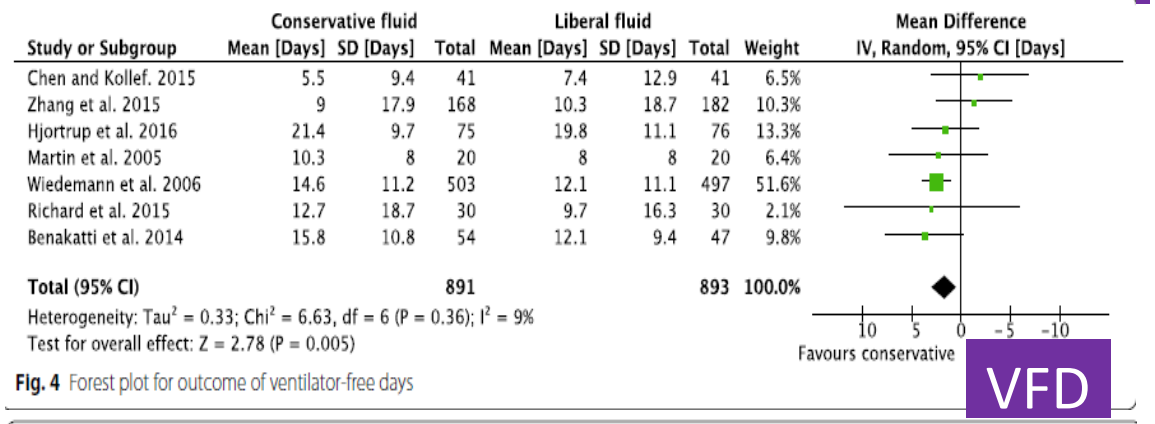


Study or Subgroup	Conservative fluid Events	Total	Liberal fluid Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
ARDS						
Hu et al. 2014	4	15	3	14	0.7%	1.24 [0.34, 4.60]
Martin et al. 2002	7	20	9	20	2.0%	0.78 [0.36, 1.68]
Martin et al. 2005	3	19	3	18	0.6%	0.95 [0.22, 4.10]
Wang et al. 2014	28	50	30	50	10.8%	0.93 [0.67, 1.30]
Wiedemann et al. 2006	128	503	141	497	28.8%	0.90 [0.73, 1.10]
Subtotal (95% CI)		**607**		**599**	**43.0%**	**0.91 [0.77, 1.07]**
Total events	170		186			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.42$, df = 4 (P = 0.98); $I^2 = 0\%$
Test for overall effect: Z = 1.16 (P = 0.25)

Risk Ratio M-H, Random, 95% CI

Mortality



Study or Subgroup	Conservative fluid Mean [Days]	SD [Days]	Total	Liberal fluid Mean [Days]	SD [Days]	Total	Weight
Chen and Kollef, 2015	5.5	9.4	41	7.4	12.9	41	6.5%
Zhang et al. 2015	9	17.9	168	10.3	18.7	182	10.3%
Hjortrup et al. 2016	21.4	9.7	75	19.8	11.1	76	13.3%
Martin et al. 2005	10.3	8	20	8	8	20	6.4%
Wiedemann et al. 2006	14.6	11.2	503	12.1	11.1	497	51.6%
Richard et al. 2015	12.7	18.7	30	9.7	16.3	30	2.1%
Benakatti et al. 2014	15.8	10.8	54	12.1	9.4	47	9.8%
Total (95% CI)			**891**			**893**	**100.0%**

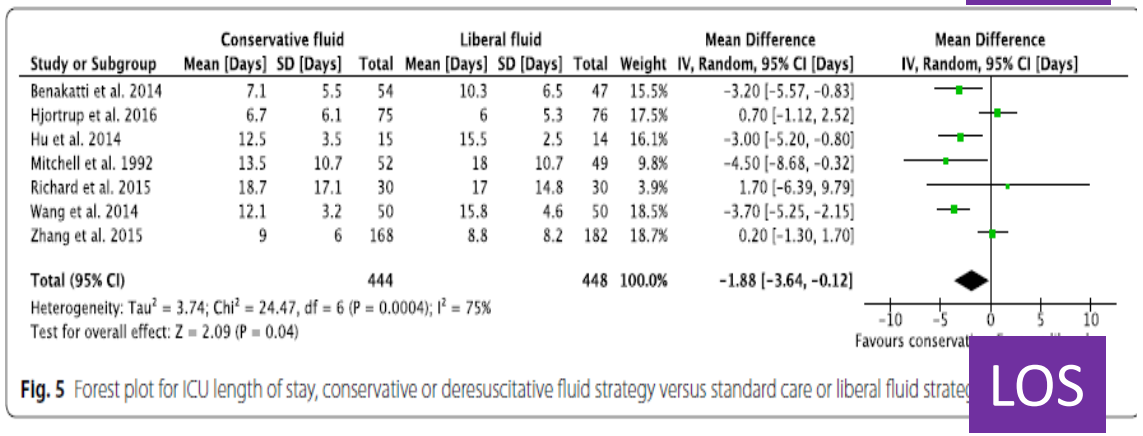
Heterogeneity: $Tau^2 = 0.33$; $Chi^2 = 6.63$, df = 6 (P = 0.36); $I^2 = 9\%$
Test for overall effect: Z = 2.78 (P = 0.005)

Mean Difference IV, Random, 95% CI [Days]

10 5 0 -5 -10
Favours conservative

Fig. 4 Forest plot for outcome of ventilator-free days

VFD



Study or Subgroup	Conservative fluid Mean [Days]	SD [Days]	Total	Liberal fluid Mean [Days]	SD [Days]	Total	Weight	Mean Difference IV, Random, 95% CI [Days]
Benakatti et al. 2014	7.1	5.5	54	10.3	6.5	47	15.5%	-3.20 [-5.57, -0.83]
Hjortrup et al. 2016	6.7	6.1	75	6	5.3	76	17.5%	0.70 [-1.12, 2.52]
Hu et al. 2014	12.5	3.5	15	15.5	2.5	14	16.1%	-3.00 [-5.20, -0.80]
Mitchell et al. 1992	13.5	10.7	52	18	10.7	49	9.8%	-4.50 [-8.68, -0.32]
Richard et al. 2015	18.7	17.1	30	17	14.8	30	3.9%	1.70 [-6.39, 9.79]
Wang et al. 2014	12.1	3.2	50	15.8	4.6	50	18.5%	-3.70 [-5.25, -2.15]
Zhang et al. 2015	9	6	168	8.8	8.2	182	18.7%	0.20 [-1.30, 1.70]
Total (95% CI)			**444**			**448**	**100.0%**	**-1.88 [-3.64, -0.12]**

Heterogeneity: $Tau^2 = 3.74$; $Chi^2 = 24.47$, df = 6 (P = 0.0004); $I^2 = 75\%$
Test for overall effect: Z = 2.09 (P = 0.04)

Mean Difference IV, Random, 95% CI [Days]

-10 -5 0 5 10
Favours conservati

Fig. 5 Forest plot for ICU length of stay, conservative or deresuscitative fluid strategy versus standard care or liberal fluid strate

LOS

Silversides JA, et al. Intensive Care Med, 2017;43:155-170

Timing & Amount of Fluid Administration is Key

- Start as early as possible the administration of volume if warranted-more conservative for patients not in shock
- Control the efficacy of volume expansion with predefined goal-oriented therapy
- More fluid early if needed, less fluid later
- Consider deresuscation if warranted after hemodynamically stable

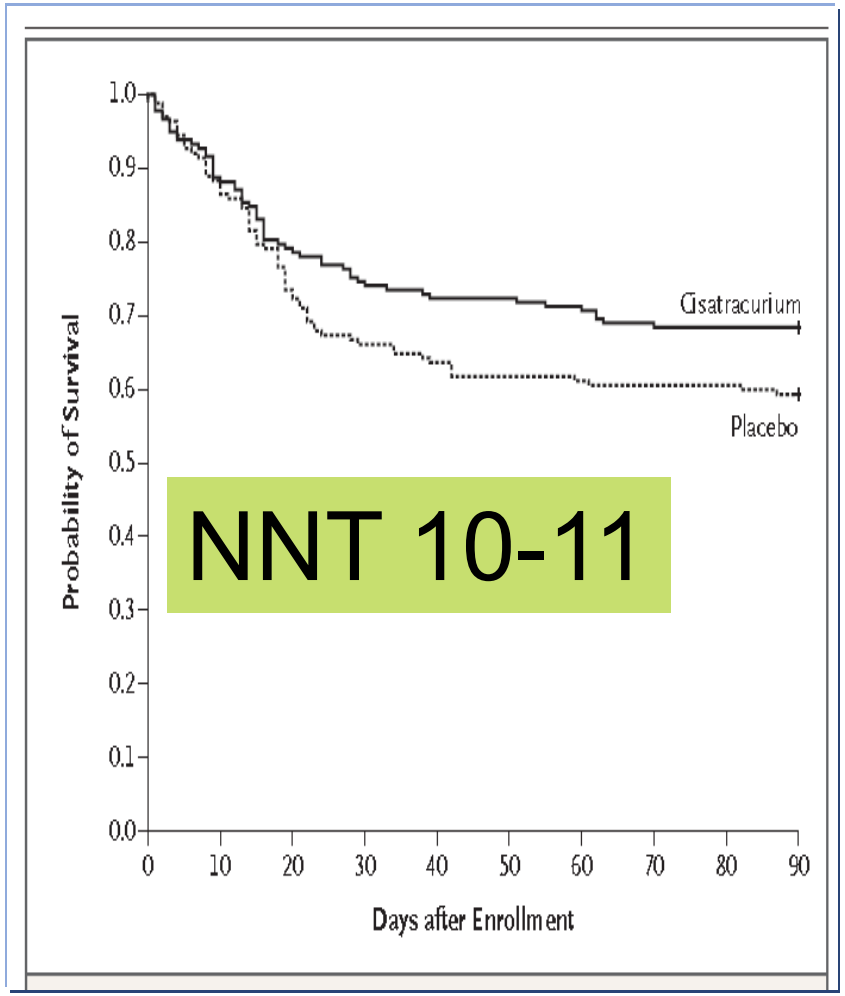
PARALYSIS

Neuromuscular Blockade in Early ARDS

- Multicenter, double blind trial
- 340 patients with ARDS within 48hrs of admitted to ICU
- ARDS defined as P/F ratio of < 150 ≥ PEEP 5cm & Vt of 6-8 ml/kg PBW
- Randomized to receive 48hrs of cisatracurium or placebo
- Study did not use train of 4

Results:

- After risk adjustment NMB group showed improved mortality at 90 days (31.6% vs. 40.7%)
- Also significant at 28 days
- ↑time off vent
- No difference in muscle weakness



NNT 10-11

Papazian L, et al. N Engl J Med. 2010;363(12):1107-16

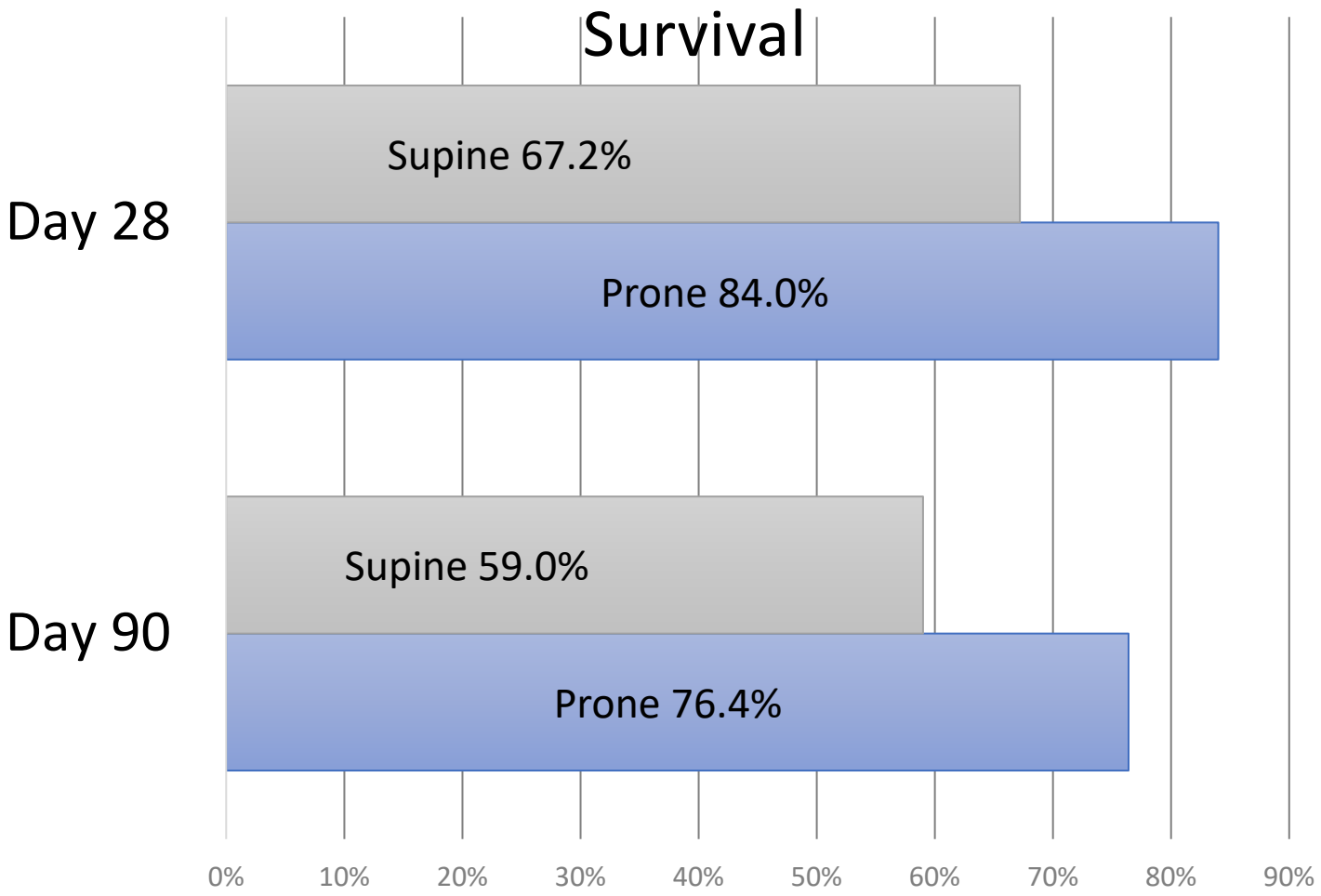
ROSE Trial

- 1006 moderate to severe ARDS patients
- Randomized to 48hrs Cisatracurium/deep sedation or usual care
- Vent strategies similar in both group (use of higher PEEP)
- Trial stopped for futility at 2nd analysis
- Results:
  - 90-day follow-up
  - Mortality: 42.5% vs. 42.8% (0.3%, 95% CI -6.4 to 5, *P*=0.93)
  - During hospital stay intervention group had more;
    - Adverse cardiovascular events
    - Less active

Moss M, et al. Petal Network. NEJM, 2019;380(21):1997-2008

POSITION

Proning Severe ARDS Patients



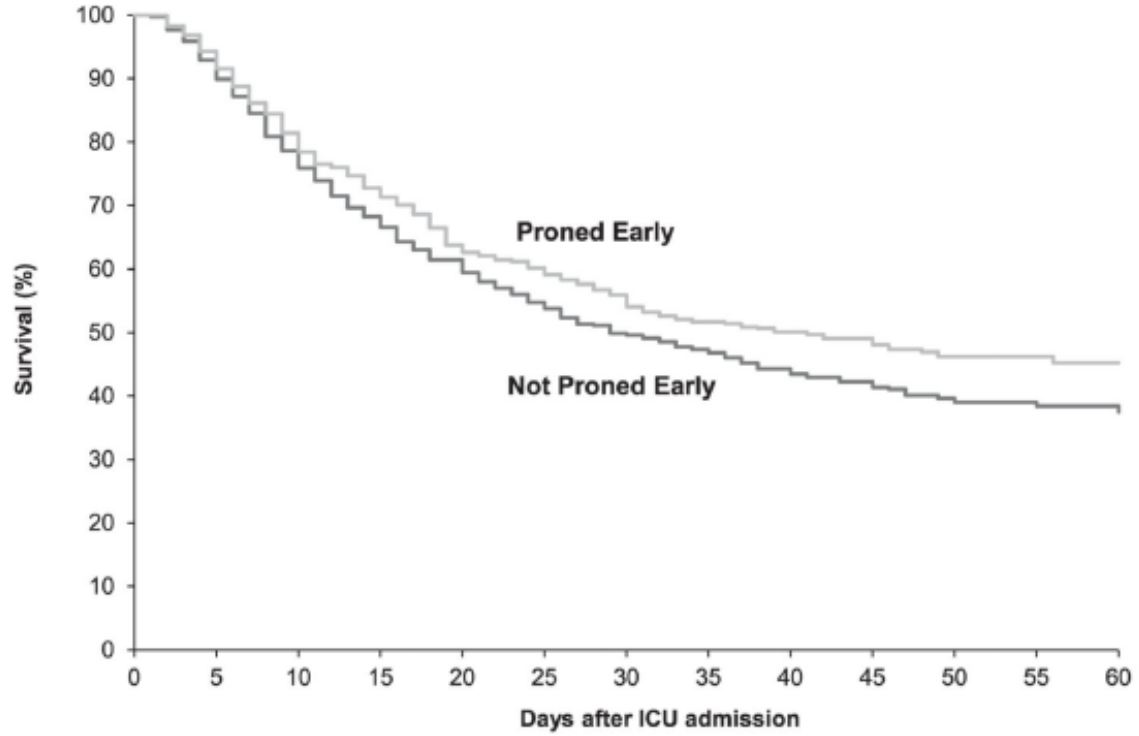
In a randomized, controlled trial of 466 patients with severe ARDS, survival was significantly higher at 28 and 90 days in the prone position group

NNT=6

Guerin C, et al. *N Engl J Med*. 2013368(23):2159-2168.

Prone Positioning in COVID 19 Patients

- Data from study & treatment of outcomes in critical ill patients with COVID
- 68 hospitals
- Patients with p/f ratio < 200mmHg initiated prone positioning or not within first 2 days of ICU admission
- Results
  - 2338 eligible pts: 30% proned
  - Lower in-hospital mortality if proned early

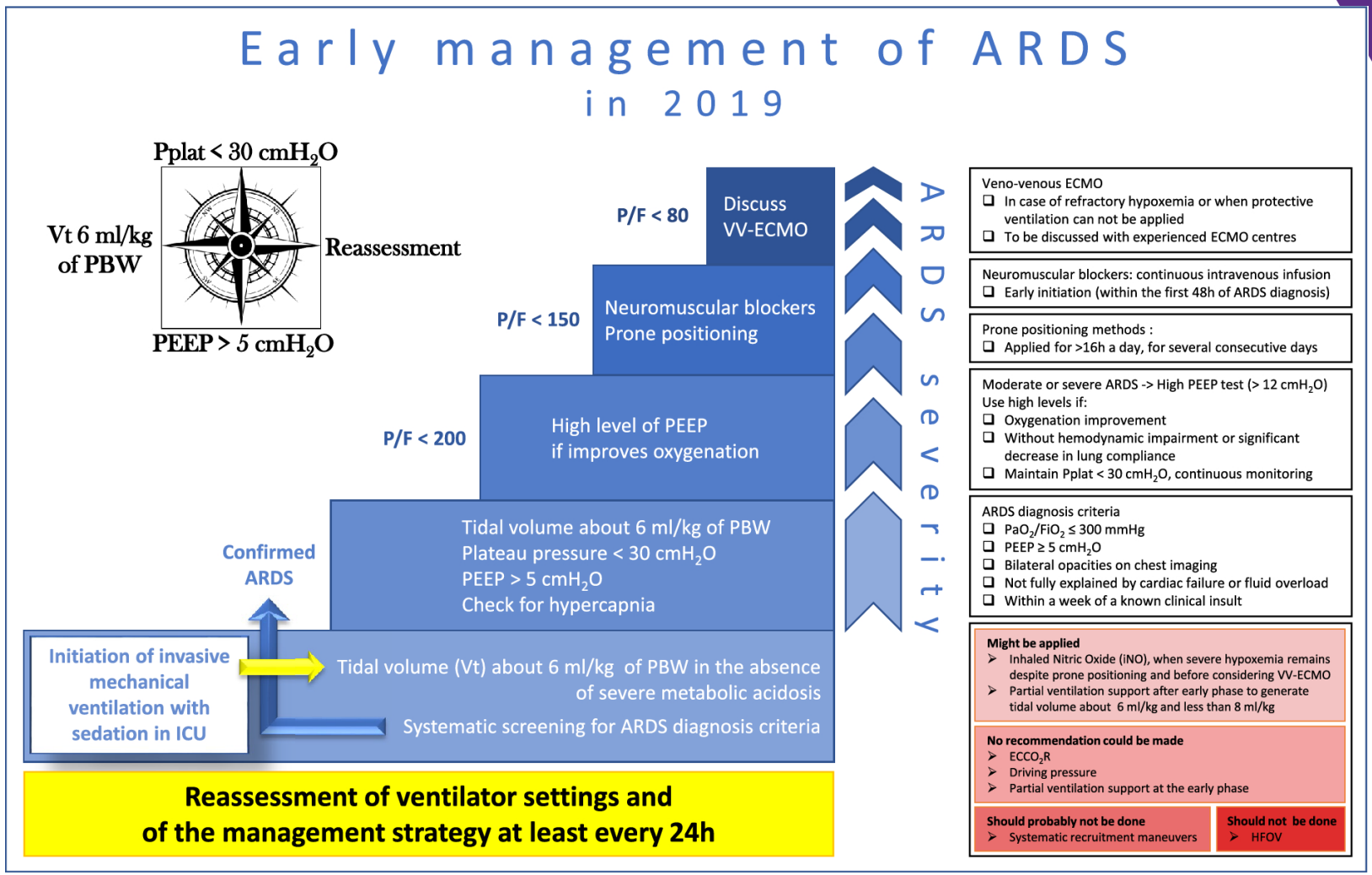


No. at risk

	Day 0	Day 10	Day 20	Day 30	Day 40	Day 50	Day 60
Proned	702	566	387	243	126	59	22
Not Proned	1636	1258	755	421	215	105	52

Mathews KS, et al. *Crit Care Med*. 2021;49(7):1026-1037.

Sample ARDS Treatment Algorithm



Papazian, L., Formal guidelines: management of acute respiratory distress syndrome. *Ann. Intensive Care* **9,** 69 (2019) Springer Open Journal

PROTEIN (NURTITION)

SSCM Nutritional Guidelines (2016)

- Initiate enteral nutrition (EN) within 24–48 hours following the onset of critical illness and admission to the ICU and increase to goals over the first week of ICU stay. For ARDS-either trophic or full EN
- Take steps as needed to reduce risk of aspiration or improve tolerance to gastric feeding
- Do not use gastric residual volumes as part of routine care to monitor ICU patients on EN
- Start parenteral nutrition early when EN is not feasible or sufficient in high-risk or poorly nourished patients
- No specific recommendation for ARDS/Severe ALI=EN formula with anti-inflammatory lipid

Taylor B, et al. Crit Care Med, 201644(2):390-438

Recommended for COVID 19 Requiring ICU

Early EN is always preferred –exceptions escalating vasopressors , high positive respiratory support , GI symptoms or bowel ischemia

Feeding via nasogastric tube is in easy to execute method that requires minimal expertise

A prokinetic agent can be used as a second step in case of GI intolerance

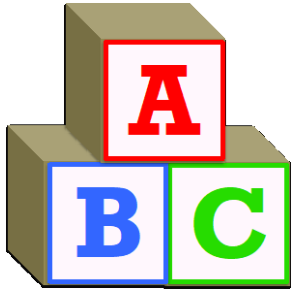
Postpyloric delivery route is only used in cases when above strategies have failed

Continuous rather than bolus is recommended

Initiate at low dose (tropic) slowly advancing to full dose over first week

Journal of Parenteral and Enteral Nutrition, Volume: 44, Issue: 8, Pages: 1439-1446, First published: 16 August 2020, DOI: (10.1002/jpen.1996)

PROTOCOL/ BUNDLE DRIVEN CARE

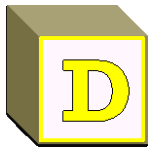


Assess & Manage Pain, Awake and Breathing Coordination:

- ↓Duration of mechanical ventilation
- ↓Duration of coma
- ↓Mortality

Manage pain first, Choose light sedation & avoid benzos

- ↓Duration of mechanical ventilation
- ↓Mortality
- ↓Delirium



Delirium monitoring & management

- ↑ Delirium detection

Early Mobility & Environment

- ↓Duration of delirium
- ↓Disability
- ↓ICU Length of Stay
- ↓Rehospitalization/Mortality

Family Engagement

Morandi et al Curr Opin Crit Care 2011;17:43-9
Vasilevskis et al Crit Care Med 2010;38:S683-91
Vasilevskis et al Chest 2010;138:1224-1233
Zaal et al, ICM 2013;39:481-88
Colombo et al, Minerva Anest 1012;78:1026-33
Chanques G, et al. Intensive Care Medicine. 2020 Dec;46(12):2342-2356.

PHARMACOLOGICAL TREATMENT

Recovery Trial: Dexamethasone in Hospitalized COVID Patients

- Controlled open label trial-176 sites
- Hospitalized COVID patients
  - 2104 randomized to steroid: 6mg x1 daily for 10 days
  - 4321 randomized to usual care

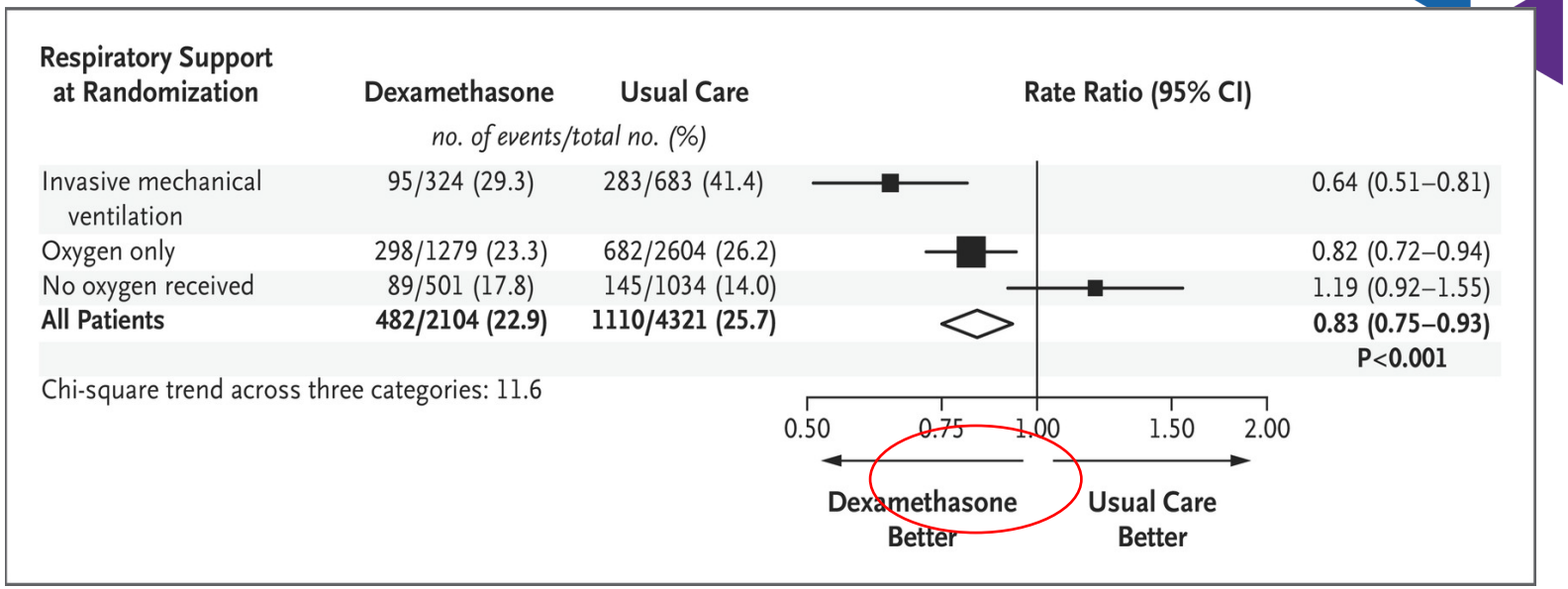


Table 2. Primary and Secondary Outcomes.

Outcome	Dexamethasone (N=2104)	Usual Care (N=4321)	Rate or Risk Ratio (95% CI)*
	no./total no. of patients (%)		
Primary outcome			
Mortality at 28 days	482/2104 (22.9)	1110/4321 (25.7)	0.83 (0.75–0.93)
Secondary outcomes			
Discharged from hospital within 28 days	1413/2104 (67.2)	2745/4321 (63.5)	1.10 (1.03–1.17)
Invasive mechanical ventilation or death†	456/1780 (25.6)	994/3638 (27.3)	0.92 (0.84–1.01)
Invasive mechanical ventilation	102/1780 (5.7)	285/3638 (7.8)	0.77 (0.62–0.95)
Death	387/1780 (21.7)	827/3638 (22.7)	0.93 (0.84–1.03)

The Recovery Collaborative Group. *New England Journal of Medicine.* 2020;384(8):693-704.

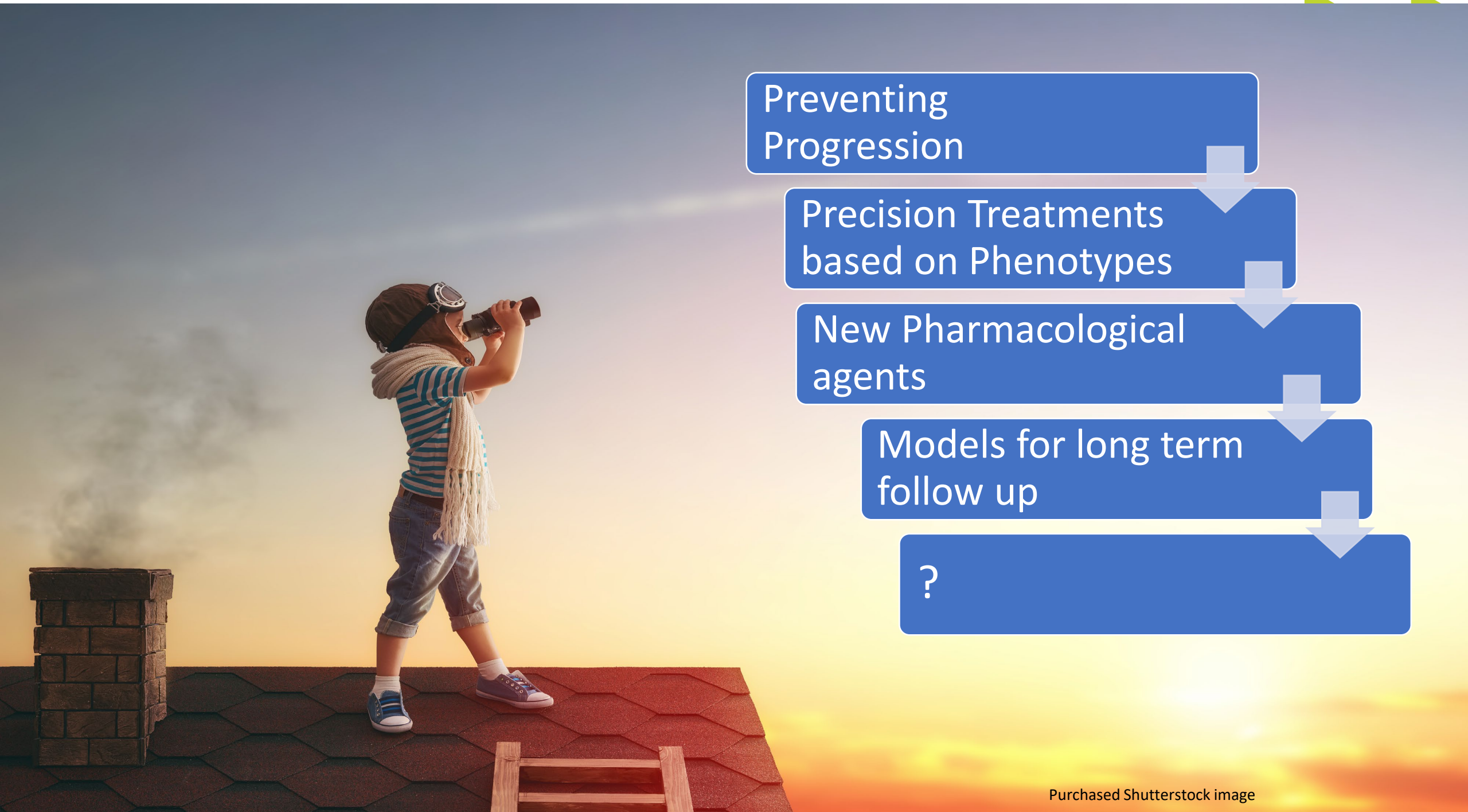
Post ICU Discharge & Long Term: How Do We Help?

Long Term Follow Up: Managing Medical Complexity

- Cognitive impairment 83.5% at d/c--51.3% at 1yr (ARDS)
- Quality of life scores & exercise intolerance remain lower than average 5 yrs. out. (ARDS)
- Peripheral nerve injuries from positioning, joint contracture from immobility, and oral or laryngeal injuries are common. (COVID)
- Critical illness erodes baseline health and increases medical complexity
- Specialized inpatient and longitudinal interprofessional and multidisciplinary team-based care

Formal Patient/Family Center Follow-Up After ARDS/COVID/Critical Illness

Herridge MS, Am J Respir Crit Care Med, 2017;196(11):1380-1384
Peach BC. Rehabilitation Nursing 2-22;47(2):72-81
Parotto M, *Lancet Respir Med*. 2021;9(8):812-814.



Purchased Shutterstock image

Questions

kvollman@comcast.net