



COVID-19

Pertinence de l'ECMOvv



Professeur Yazine MAHJOUB

Réanimation CTVR

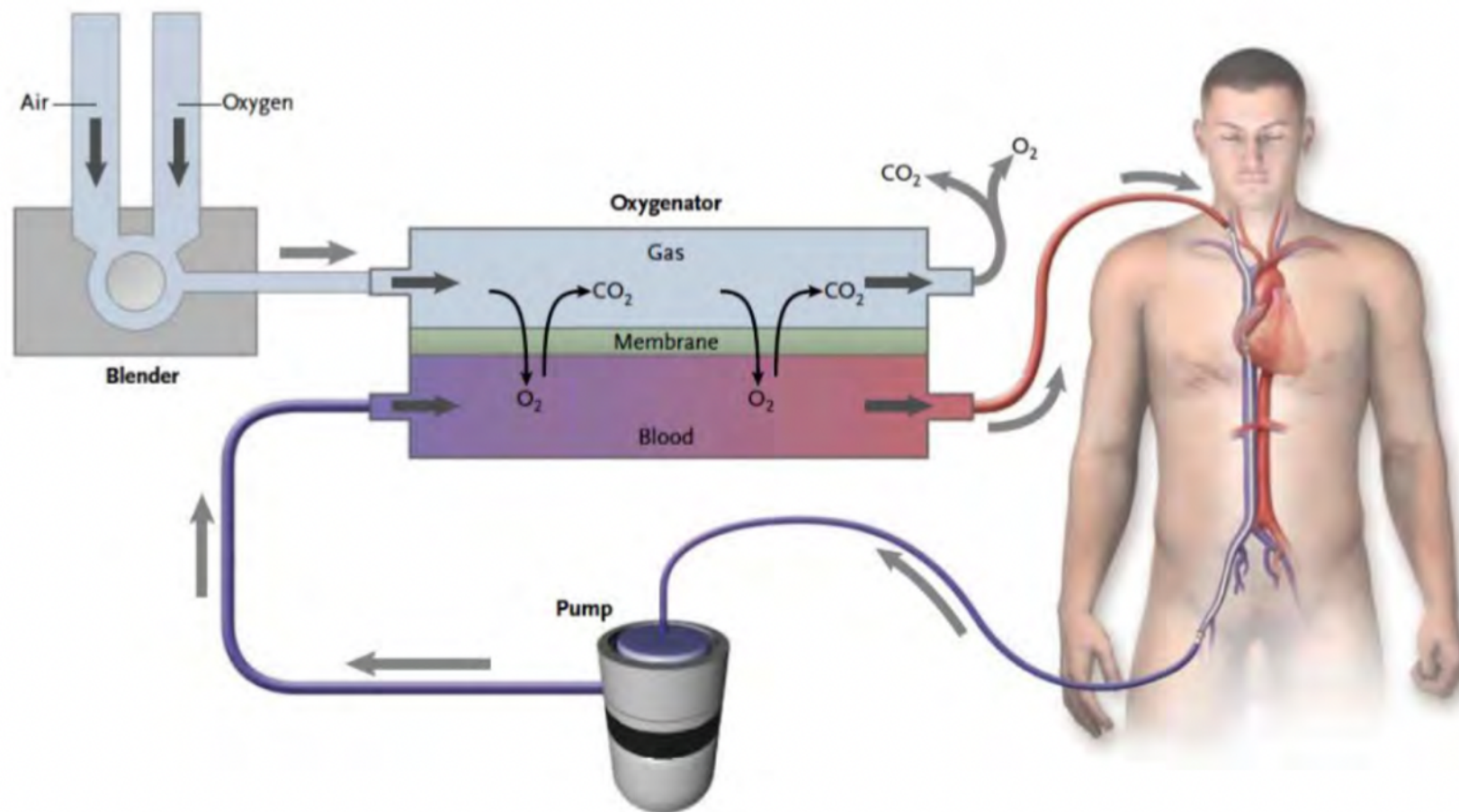
Pôle d'Anesthésie-Réanimation

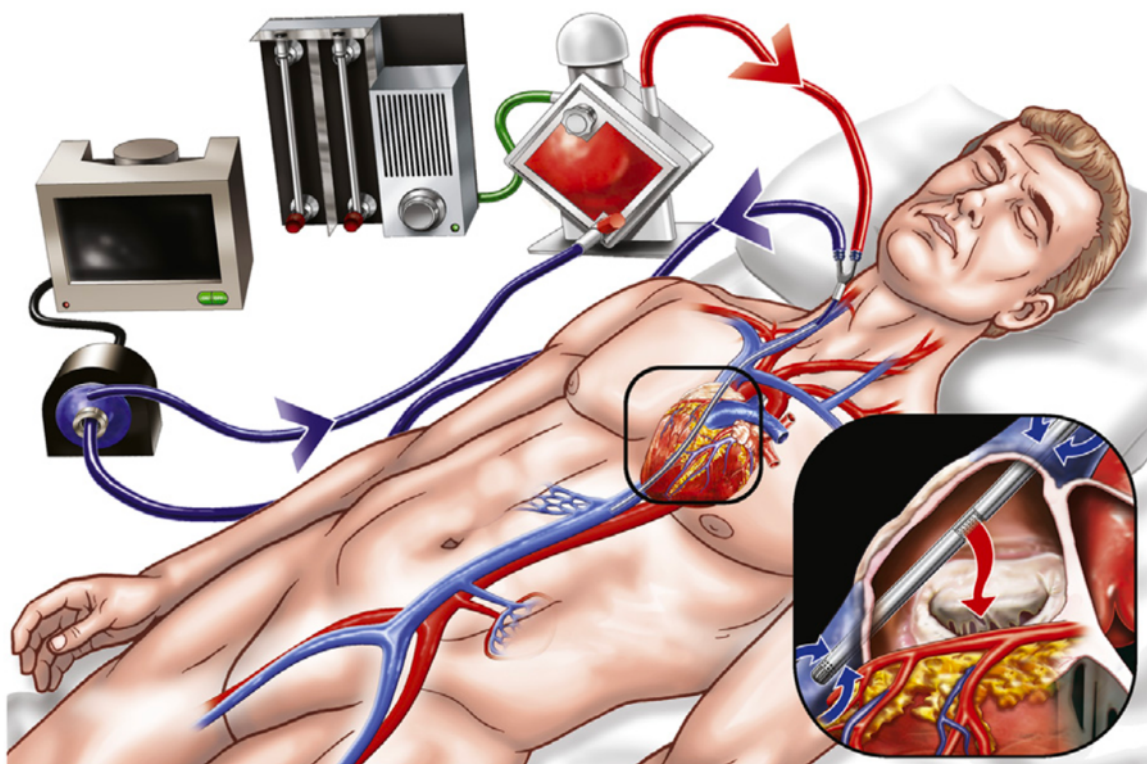
CHU Amiens-Picardie

AMIENS-FRANCE

Pas de conflit d'intérêt

Principe de l'ECMO veino-veineuse

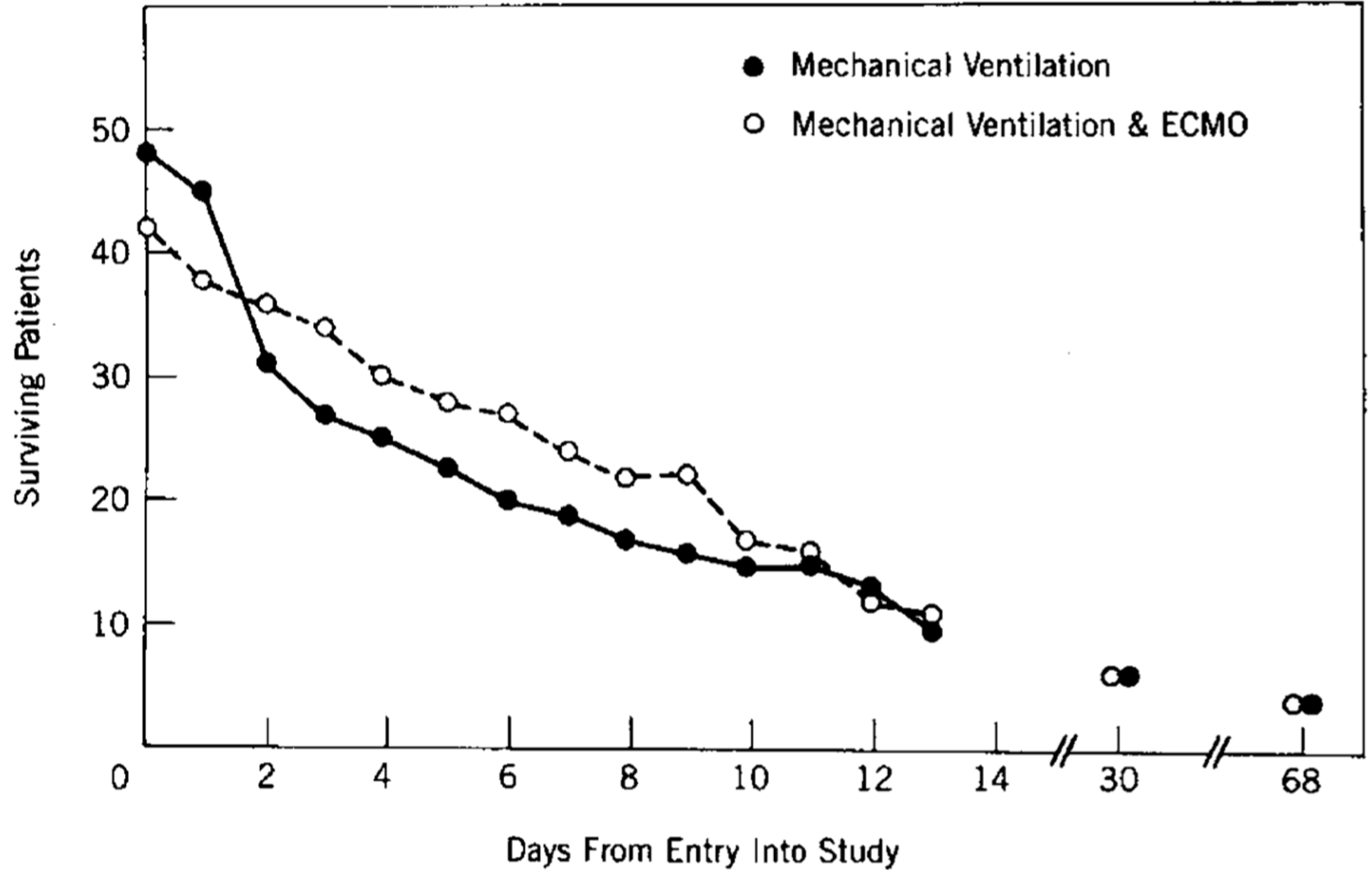




ECMO avant le COVID-19

- 1 étude ancienne**
- 2 études randomisées**
- 3 études de cohortes**

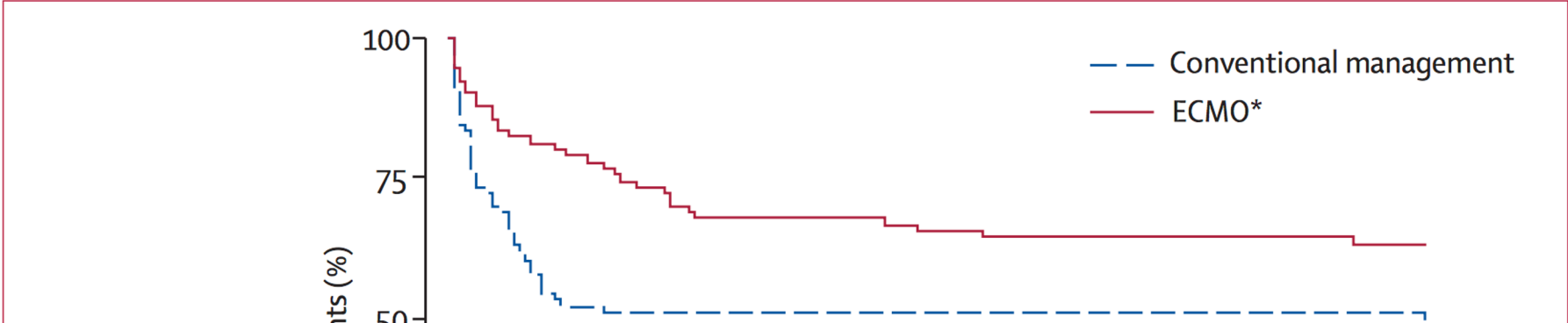
- 48 VM
- vs
- 42 VM +ECMO



Zapol WM, JAMA 1979

- CESAR
- 90 VM
- Vs
- 90 VM+ECMO

Critère composite :
survie+handicap sévère



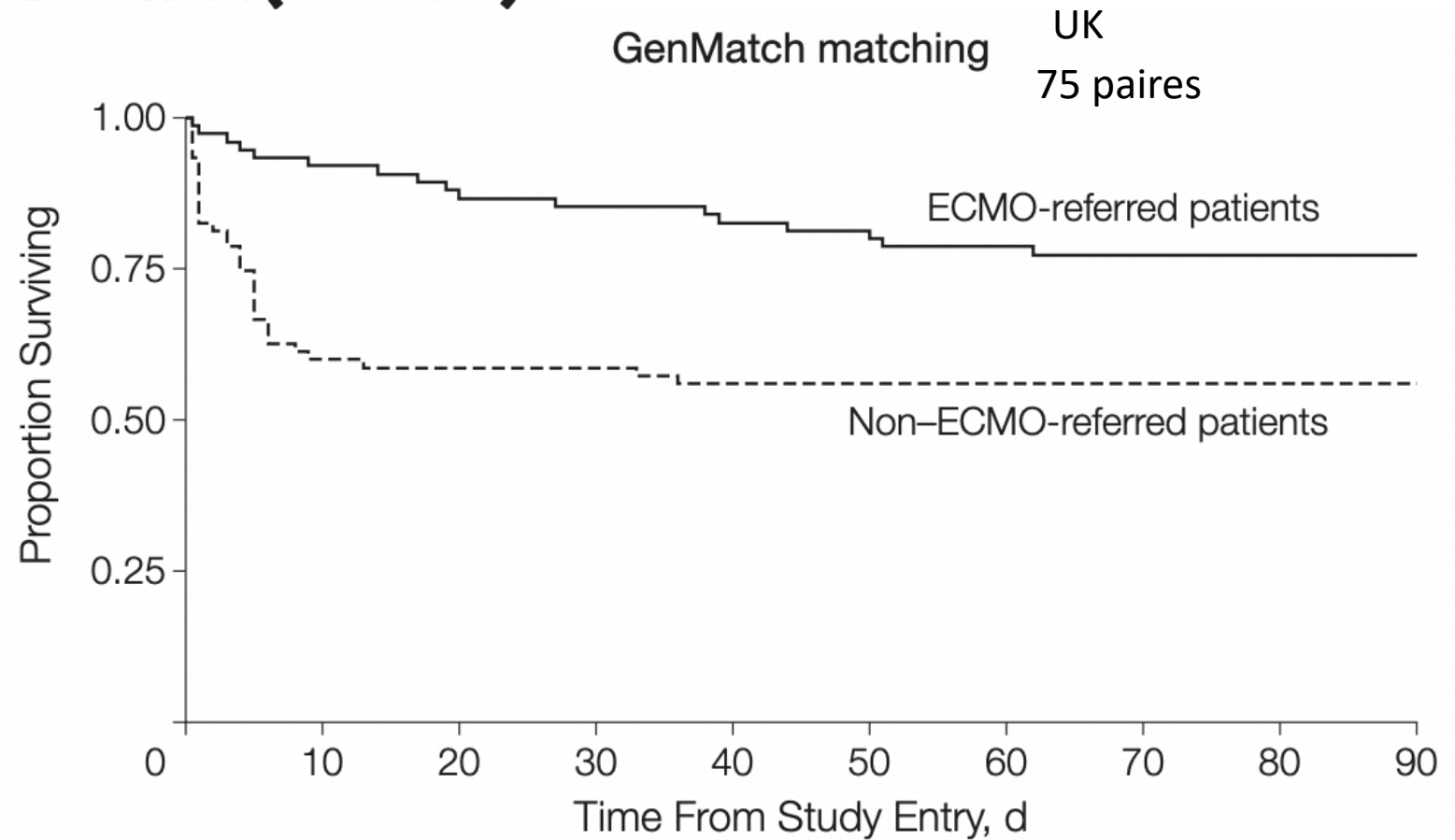
		ECMO group (n=90)*	Conventional management group (n=90)	Relative risk (95% CI, p value)	
Death or severe disability at 6 months		NA	NA	0.69 (0.05–0.97, 0.03)†	
No		57 (63%)	41 (47%)‡	NA	
Yes		33 (37%)	46 (53%)‡	NA	
Patients at risk					
Conventional management	90	45	44	44	0
ECMO*	90	61	59	58	0

Figure 2: Kaplan-Meier survival estimates
ECMO=extracorporeal membrane oxygenation. *Patients were randomly allocated to consideration for treatment by ECMO, but did not necessarily receive this treatment.

Referral to an Extracorporeal Membrane Oxygenation Center and Mortality Among Patients With Severe 2009 Influenza A(H1N1)²⁰¹¹



Mortalité 24 vs 51 %
($p=0,001$)



Extracorporeal Membrane Oxygenation for Pandemic Influenza A(H1N1)-induced Acute Respiratory Distress Syndrome

A Cohort Study and Propensity-matched Analysis

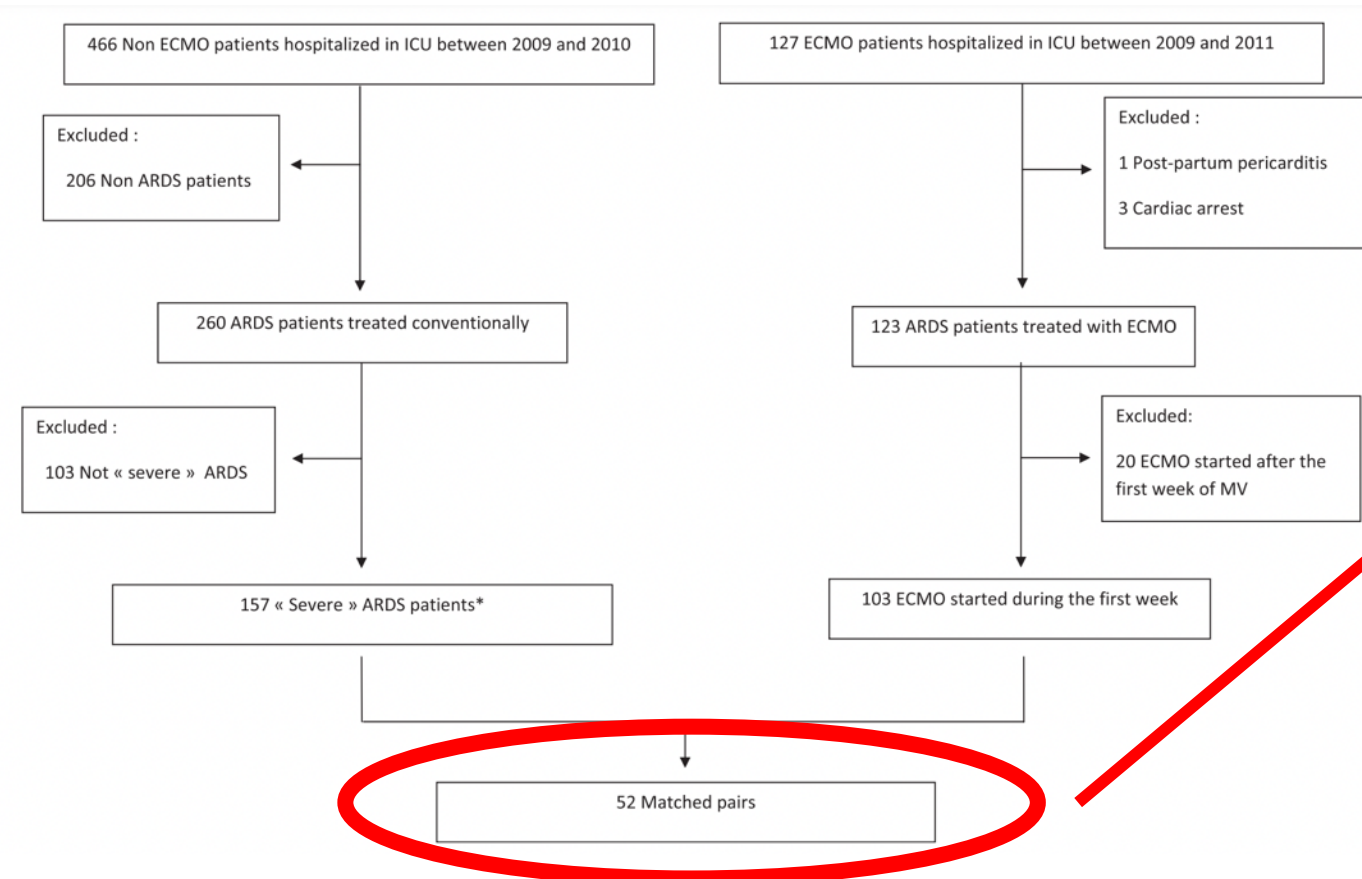
REVA study

Tài Pham^{1,2}, Alain Combes^{3,4}, Hadrien Rozé⁵, Sylvie Chevret^{2,6}, Alain Mercat^{7,8}, Antoine Roch^{9,10},

2013

American Journal of Respiratory and Critical Care Medicine

Publishes the most innovative science and highest quality reviews, practice guidelines, and statements in the pulmonary, critical care, and sleep-related fields



this well-matched subgroup of patients, we found no significant difference in ICU mortality (40% in the conventional treatment group vs. 50% in the ECMO group; OR for death of ECMO patients, 1.48; 95% CI, 0.68–3.23; $P = 0.32$).

Pas de différence de mortalité

Acute Respiratory Distress Syndrome With and Without Extracorporeal Membrane Oxygenation: A Score Matched Study

THE ANNALS
OF
THORACIC SURGERY

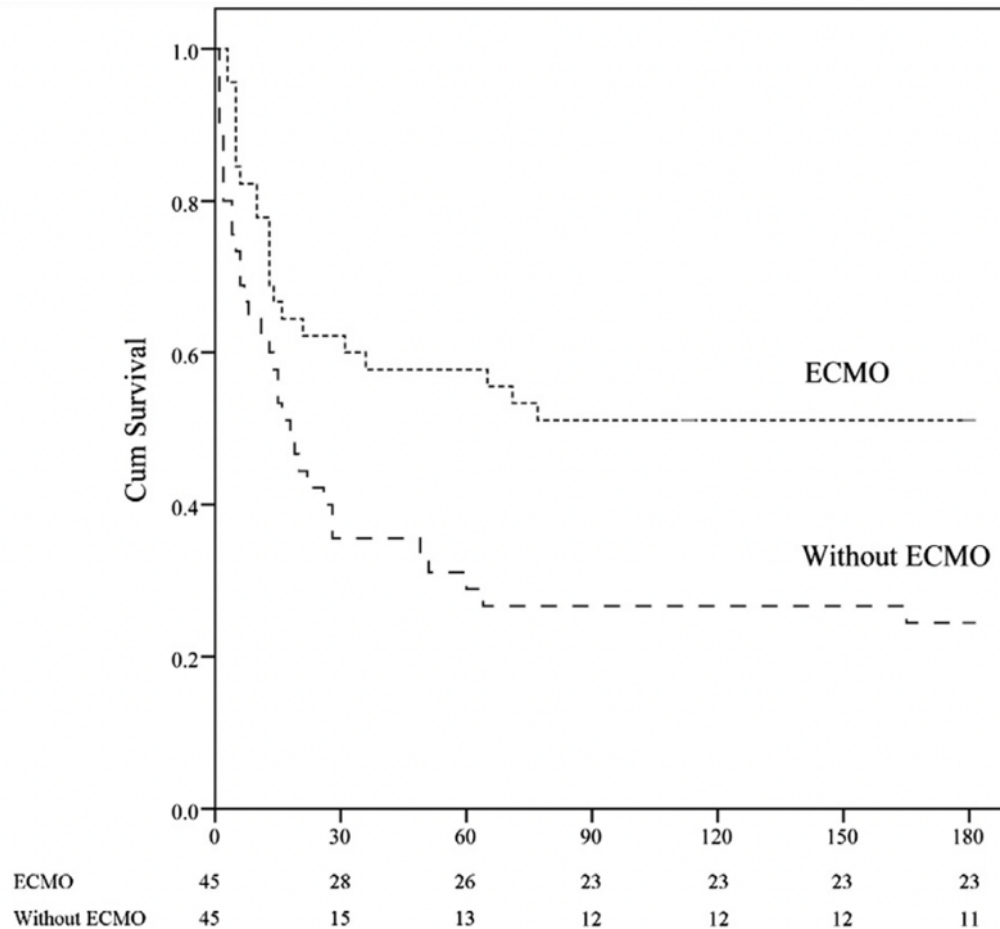
Hsiao-Chi Tsai, MD,* Chih-Hsiang Chang, MD,* Feng-Chun Tsai, MD,

2015

45 paires

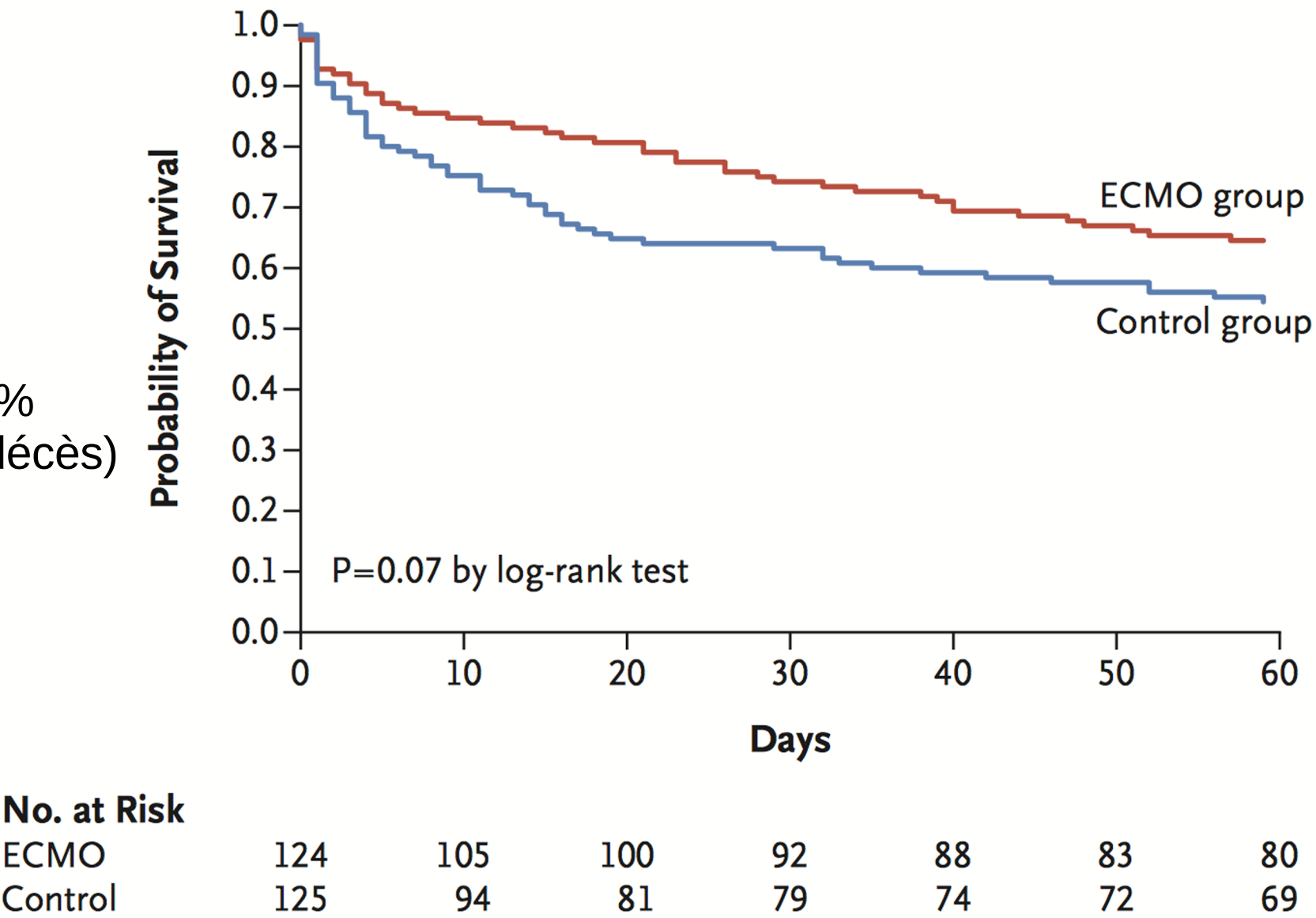
Mortalité 49% vs 76 %

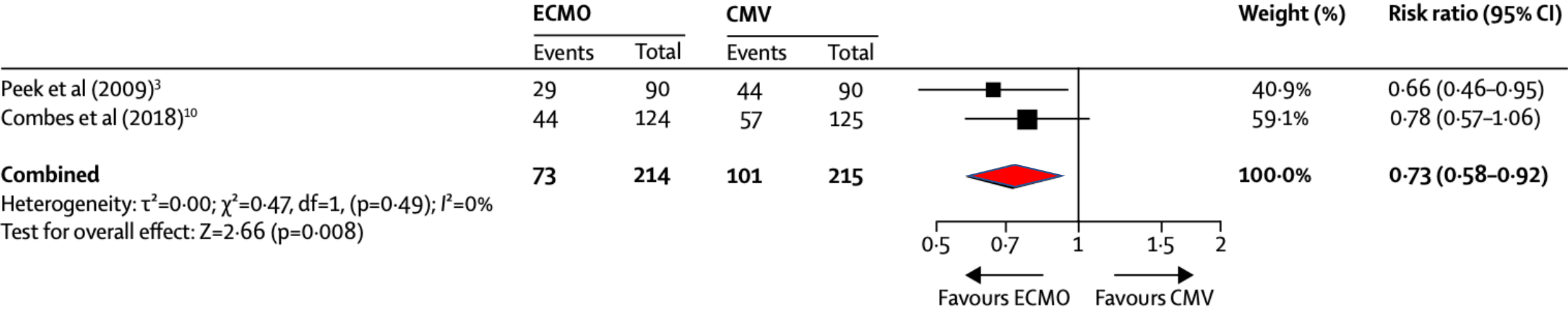
P<0,001



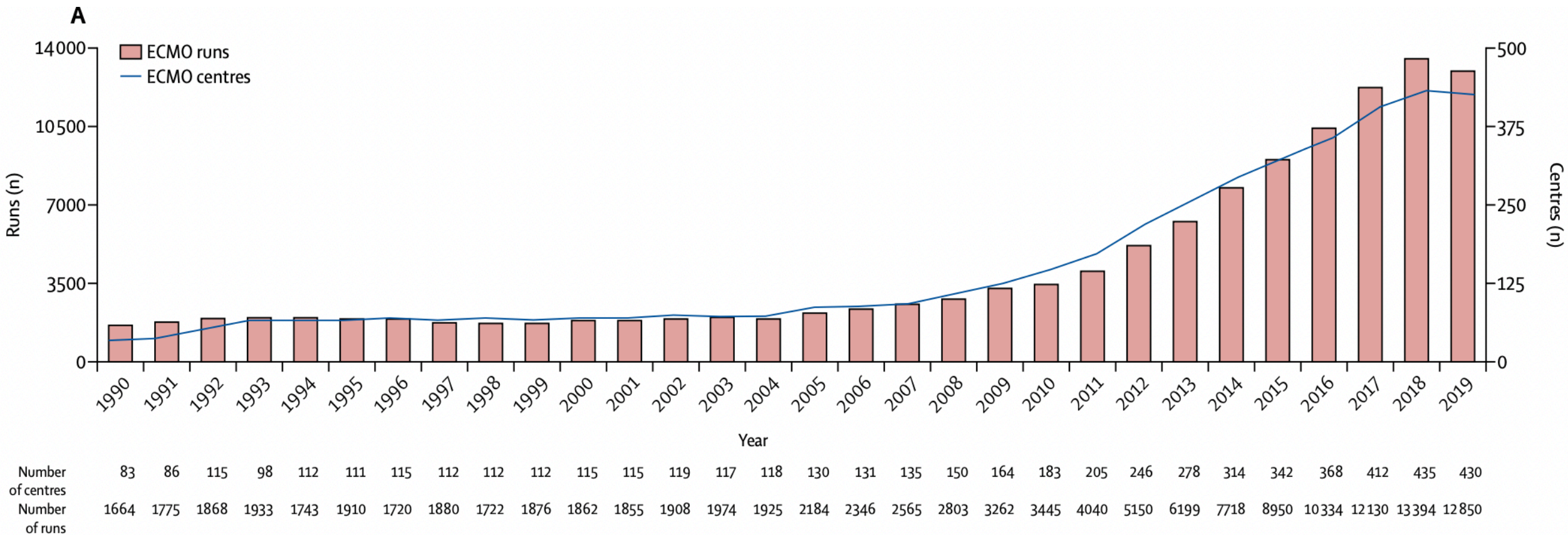
EOLIA
125 VM
Vs
124 VM+ECMO

(cross over 28 %
Dont 57 % de décès)



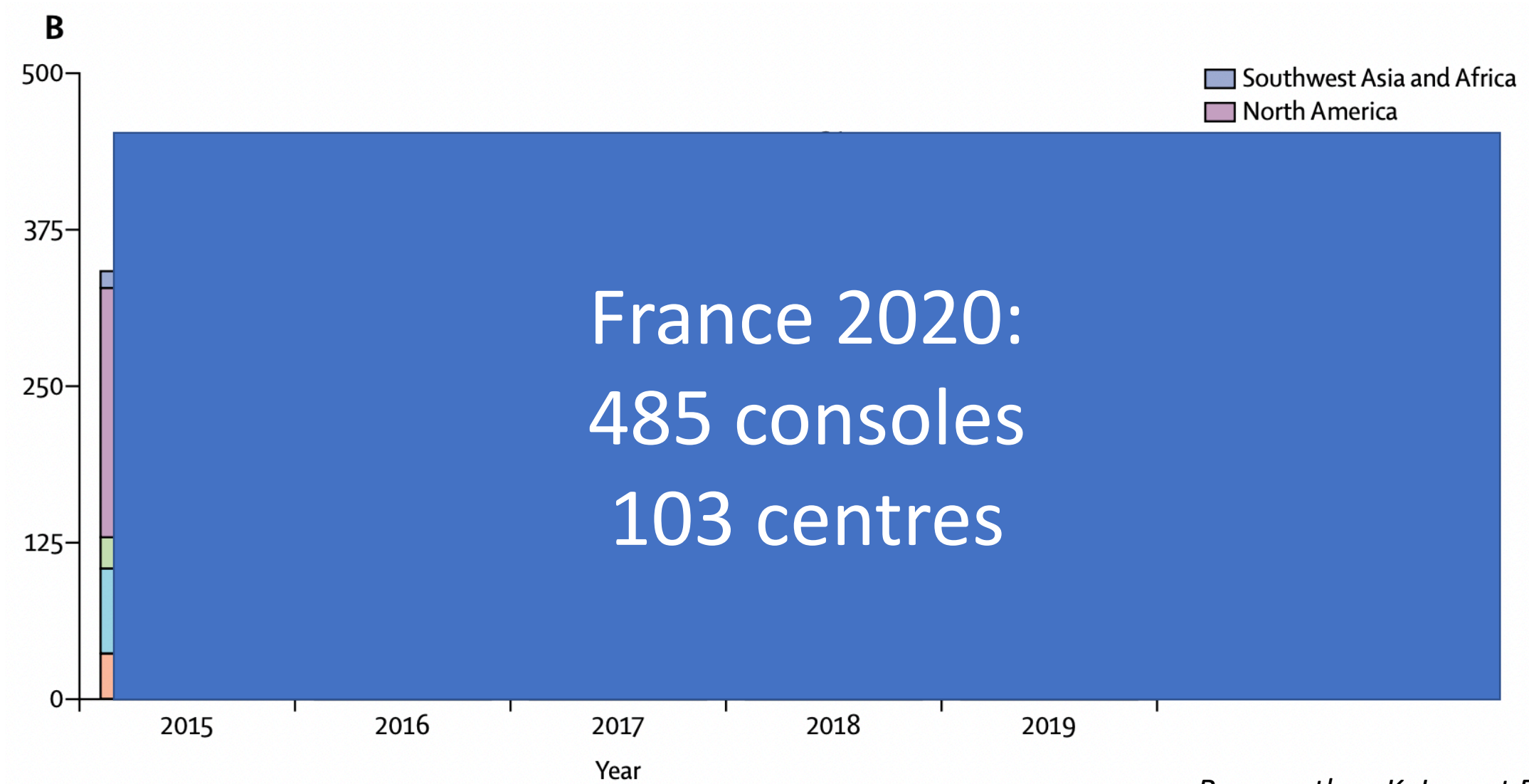


Evolution: nombre de centres , nombre d'ECMO (ELSO)



Ramanathan K, Lancet Respir Med 2020

Nombre de centres enregistrés à l'ELSO



Indications ECMO/SDRA

$\text{PaO}_2/\text{FiO}_2 < 100$
Et/ou
Acidose respiratoire pH $< 7,25$
malgré
2 séances de DV de 16 h
Curarisation
Ventilation protectrice et haute PEEP
+/- recrutement



Age > 75 ans
Défaillance multi viscérale
Comorbidités des patients
Autonomie à domicile

Discussion multidisciplinaire
pour chaque cas

COVID-19 Outbreak in France: Setup and Activities of a Mobile Extracorporeal Membrane Oxygenation Team During the First 3 Weeks



Guillaume Haye, MD*

Alex Fourdrain, MD†

Osama Abou-Arab, MD, PhD*

Pascal Berna, MD†

Yazine Mahjoub, MD, PhD*



30 ECMO en UMAC en 2021

66 au total



Rayon de 130 km autour d'Amiens

Extracorporeal membrane oxygenation for COVID-19-associated severe acute respiratory distress syndrome and risk of thrombosis

Christophe Beyls^{*}, Pierre Huet, Osama Abou-Arab, Pascal Berna and Yazine Mahjoub

Amiens, France
2020



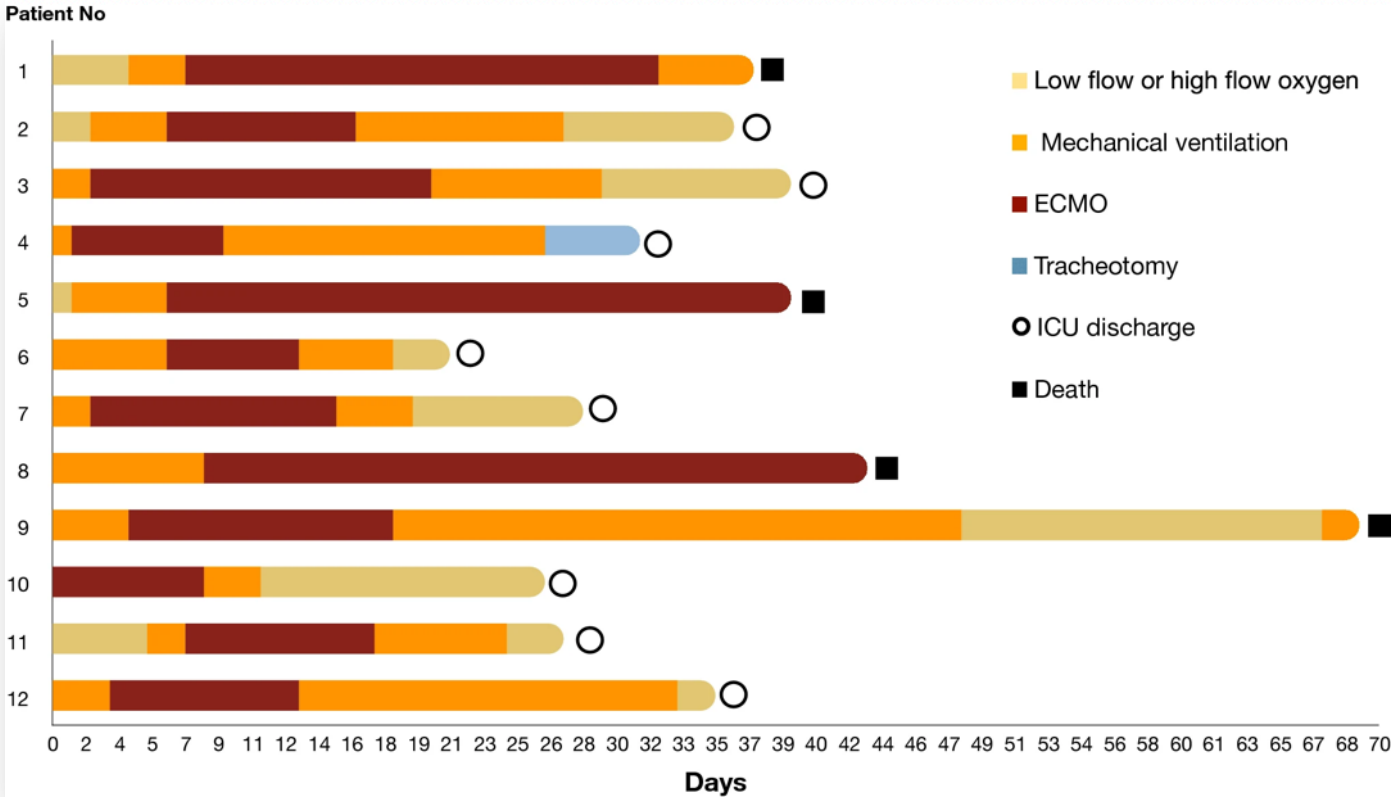
White blood count (mm ⁻³)	10.900 (9525–11875)
Lymphocyte count × 10 ⁶ L ⁻¹	616 (397–900)
Platelet count × 10 ⁹ L ⁻¹	240 (151–329)
C-reactive protein (mg L ⁻¹)	280 (214–345)
Procalcitonin (μg L ⁻¹)	2.6 (1.7–7)
aPTT	1.4 (1.3–1.5)
PT (%)	60 (52–70)
Anti-Xa UFH assay (IU ml ⁻¹)	0 (0–0.2)
Fibrinogen (g L ⁻¹)	7 (6–9)
D-Dimer (μg ml ⁻¹)	8.3 (4.7–24)
Fibrinogen	51 (3–76)

Évènements thrombo emboliques majeures chez 9 patients sur 12

- Thrombose ECMO pendant la procédure avec 2 décès sur EP massive (4 patients): *canule*, *oxygénateur*,
- TVP malgré l'héparine à doses curatives (5 patients)

Extracorporeal membrane oxygenation for respiratory failure in COVID-19 patients: outcome and time-course of clinical and biological parameters

Pierre Huette, MD  · Christophe Beyls, MD · Mathieu Guilbart, MD · Alexandre Coquet, MD · Pascal Berna, MD, PhD · Guillaume Haye, MD · Pierre-Alexandre Roger, MD · Patricia Besserve, MD · Michael Bernasinski, MD · Hervé Dupont, MD, PhD · Osama Abou-Arab, MD, PhD · Yazine Mahjoub, MD, PhD



Mortalité hospitalière 33%



Variables	n=14
Age (années)	62 [58-64]
Vt	6.1 [5.9-6.2]
PEEP	14 [13-15]
Plateau pressure	29 [28-30]
Compliance	30 [27-32]
PaO ₂ /FiO ₂	76 [66-83]
SOFA	11.5 [10-14]
Durée VM avant ECMO (j)	4

Extracorporeal Membrane Oxygenation for Respiratory Failure Related to COVID-19: A Nationwide Cohort Study FREE

CME 

Nicolas Nessler, M.D., Ph.D.; [Guillaume Fadel, M.D.](#); Alexandre Mansour, M.D.; Marylou Para, M.D.; Pierre-Emmanuel Falcoz, M.D., Ph.D.; Nicolas Mongardon, M.D., Ph.D.; Alizée Porto, M.D.; Astrid Bertier, M.D.; Bruno Levy, M.D., Ph.D.; Cyril Cadoz, M.D.; ... [Show more](#)

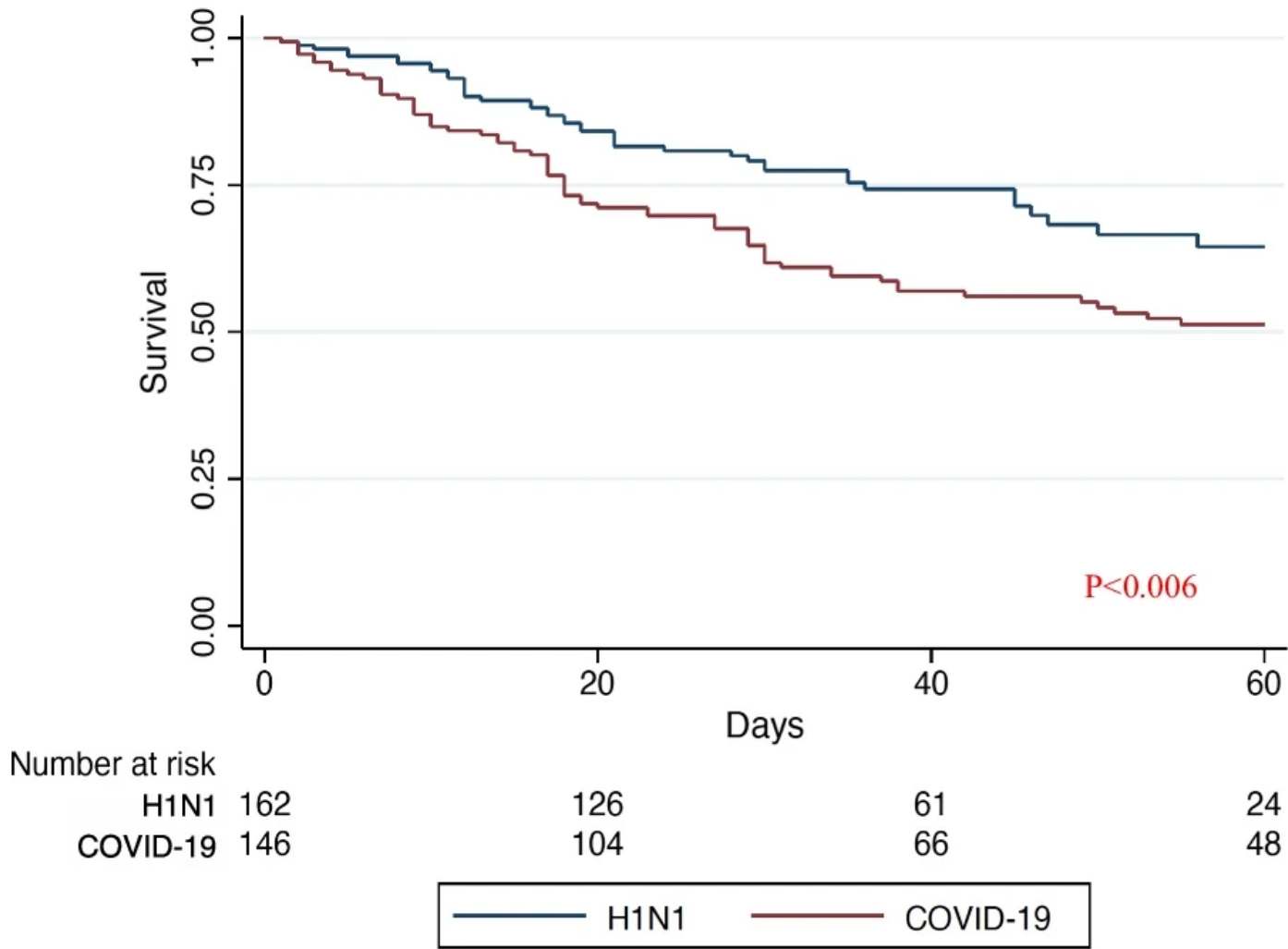
Results: Among 494 extracorporeal membrane oxygenation patients included in the registry, 429 were initially supported by venovenous extracorporeal membrane oxygenation and followed for at least 28 days. The median (interquartile range) age was 54 yr (46 to 60 yr), and 338 of 429 (79%) were men. Management before extracorporeal membrane oxygenation cannulation included prone positioning for 411 of 429 (96%), neuromuscular blockage for 419 of 427 (98%), and NO for 161 of 401 (40%). A total of 192 of 429 (45%) patients were cannulated by a mobile extracorporeal membrane oxygenation unit. In-hospital mortality was 219 of 429 (51%), with a median follow-up of 49 days (33 to 70 days). Among pre-extracorporeal membrane oxygenation modifiable exposure variables, neuromuscular blockage use (hazard ratio, 0.286; 95% CI, 0.101 to 0.81) and duration of ventilation (more than 7 days compared to less than 2 days; hazard ratio, 1.74; 95% CI, 1.07 to 2.83) were independently associated with in-hospital mortality. Both age (per 10-yr increase; hazard ratio, 1.27; 95% CI, 1.07 to 1.50) and total bilirubin at cannulation (6.0 mg/dl or more compared to less than 1.2 mg/dl; hazard ratio, 2.65; 95% CI, 1.09 to 6.5) were confounders significantly associated with in-hospital mortality.

47 centres en France
Avril 2020-octobre 2020
(1^{ière} vague...)

51 %

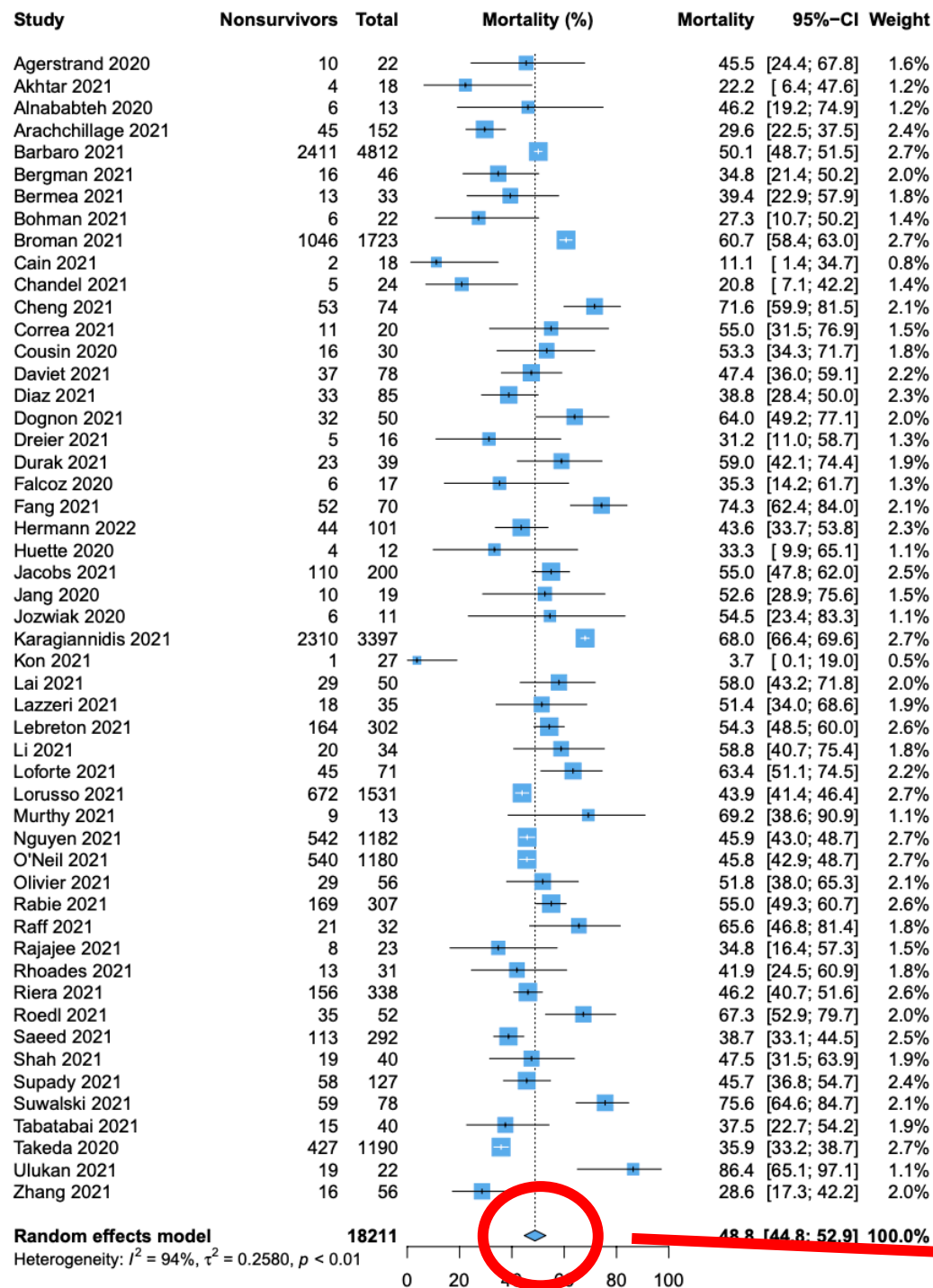


Extracorporeal membrane oxygenation for COVID-19 and influenza H1N1 associated acute respiratory distress syndrome: a multicenter retrospective cohort study



70 % H1N1
50 % COVID19

52 études



RESEARCH

Open Access



Evolving outcomes of extracorporeal membrane oxygenation during the first 2 years of the COVID-19 pandemic: a systematic review and meta-analysis

Ryan Ruiyang Ling^{1†}, Kollengode Ramanathan^{1,2*†}, Jackie Jia Lin Sim¹, Swei Nee Wong³, Ying Chen⁴, Faizan Amin⁵, Shannon M. Fernando⁶, Bram Rochweg^{5,7}, Eddy Fan⁸, Ryan P. Barbaro^{9,10}, Graeme MacLaren^{1,2}, Kiran Shekar^{11,12,13†} and Daniel Brodie^{14,15†}

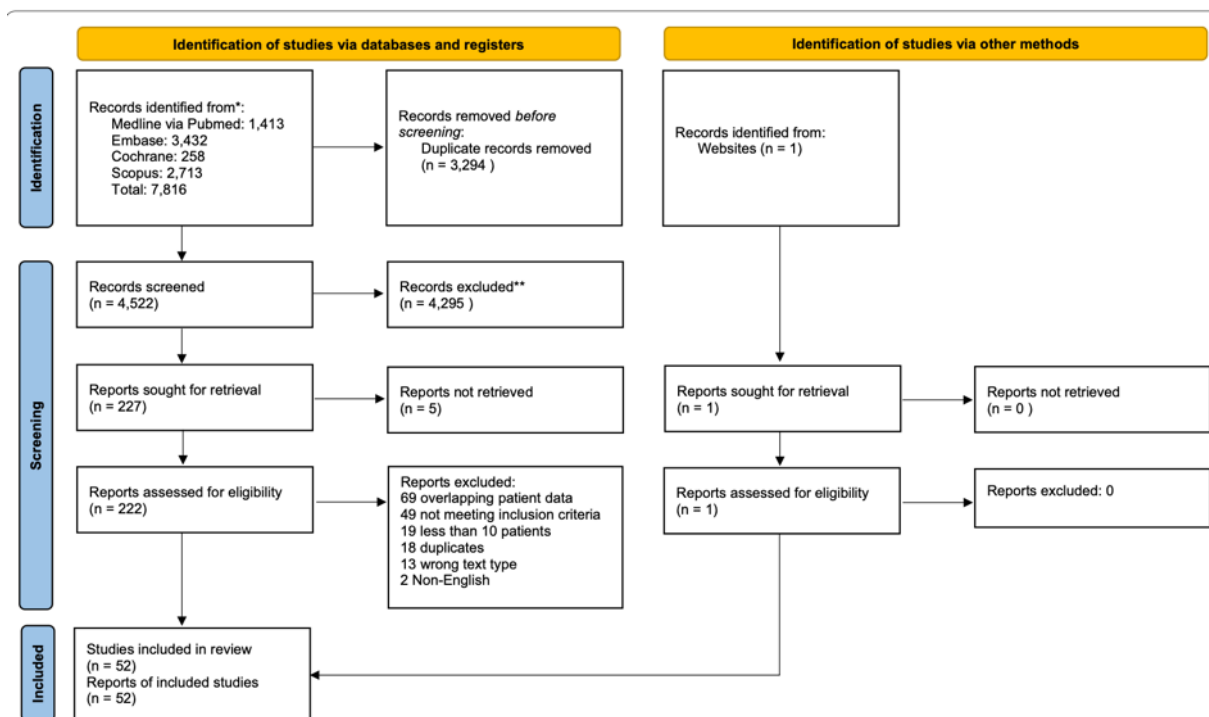


Fig. 1 Preferred Reporting Items for Systematic Reviews and Meta-analyses flow diagram

49[45-53]%

Extracorporeal membrane oxygenation network organisation and clinical outcomes during the COVID-19 pandemic in Greater Paris, France: a multicentre cohort study

	Odds ratio (95% CI)	p value
Age, years	..	0.012
≤48	2.89 (1.41–5.93)	..
49–56	2.01 (1.01–3.99)	..
≥57	1 (ref)	..
Pre-ECMO renal component of the SOFA-II score, per point increase	0.67 (0.55–0.83)	0.0003
Time between intubation and ECMO, per day decrease	0.91 (0.84–0.99)	0.022
Centre with ≥30 venovenous ECMOs in previous year	2.98 (1.46–6.04)	0.0026
ARDS=acute respiratory distress syndrome. ECMO=extracorporeal membrane oxygenation. SOFA=Sequential Organ Failure Assessment.		

Survie à 90 j

Predicting survival after extracorporeal membrane oxygenation for severe acute respiratory failure. The Respiratory Extracorporeal Membrane Oxygenation Survival Prediction (RESP) score



Âge yr
PaCO₂ mmHg
Pic pression inspiratoire cmH₂O

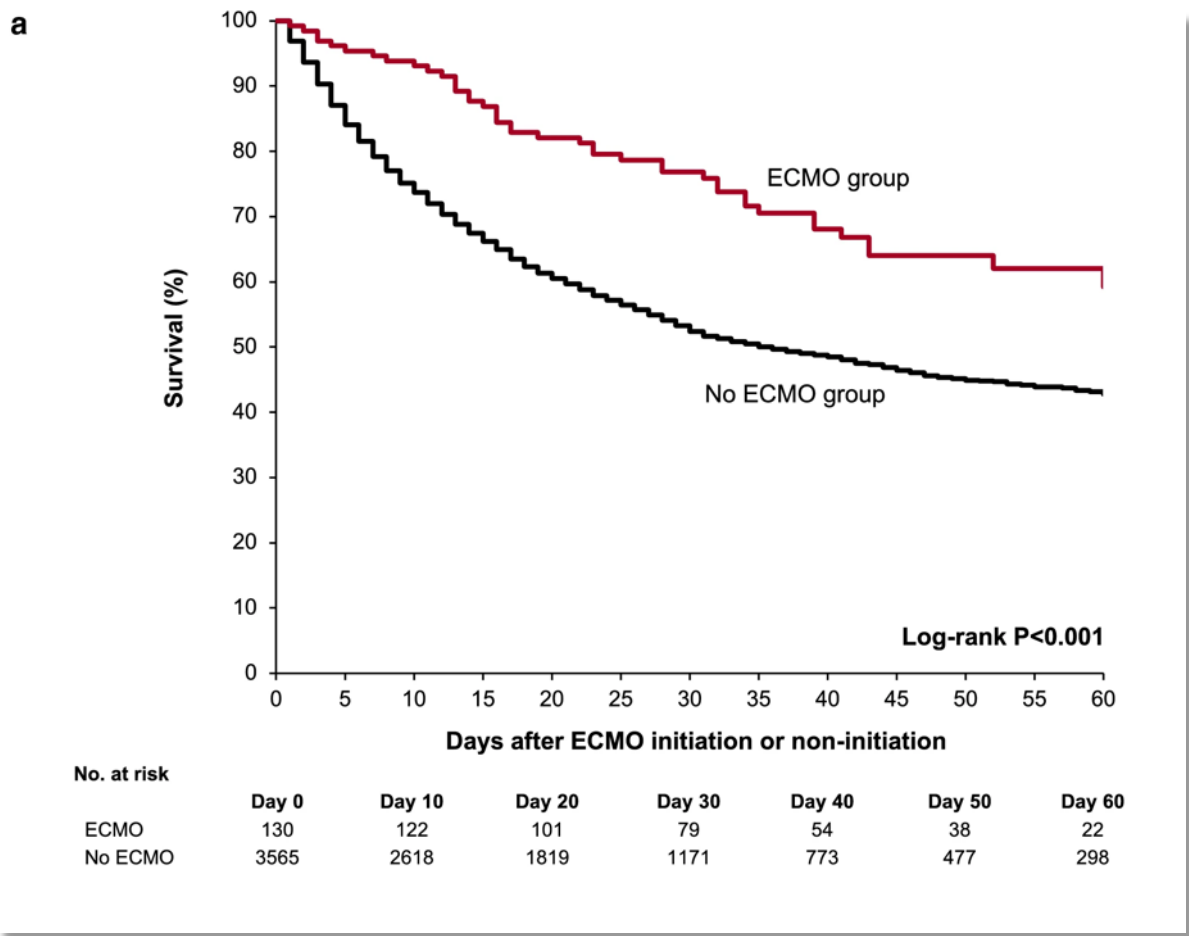
- ☐ Immunodéprimé (-2)
- ☐ Dysfonction du SNC (-7)
- ☐ Infection non pulmonaire aiguë (-3)
- ☐ Bloc neuromusculaire utilisé avant l'ECMO (1)
- ☐ Utilisation d'oxyde nitrique avant l'ECMO (-1)
- ☐ Perfusion de bicarbonate avant l'ECMO (-2)
- ☐ Arrêt cardiaque avant l'ECMO (-2)

- Sous respirateur avant ECMO**
- ☐ < 48 heures (3)
 - ☐ 48 heures à 7 jours (1)
 - ☐ > 7 jours (0)

- Pneumopathie aiguë**
- ☐ Pneumonie virale ou bactérienne (3)
 - ☐ Asthme (11)
 - ☐ Traumatisme/Brûlure (3)
 - ☐ Pneumonie d'inhalation (5)
 - ☐ Autre pneumopathie aiguë (1)
 - ☐ Maladie pulmonaire ou non pulmonaire chronique (0)

6 - 15 points:	Catégorie de risque I avec une survie à 92 %
3 - 5 points:	Catégorie de risque II avec une survie à 76 %
-1 - 2 points:	Catégorie de risque III avec une survie à 57 %
-5 - -2 points:	Catégorie de risque IV avec une survie à 33 %
-22 - -6 points:	Catégorie de risque V avec une survie à 18 %

Extracorporeal membrane oxygenation in patients with severe respiratory failure from COVID-19



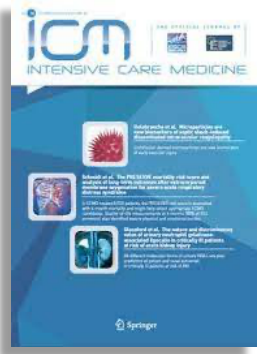
	No. deaths / No. patients (%)		Unadjusted HR (95% CI)	Adjusted HR (95% CI)	Favors ECMO	Favors no ECMO
	ECMO	No ECMO				
PaO₂/FiO₂ <100 mm Hg						
Primary analysis	45/130 (34.6)	1744/3565 (48.9)	0.52 (0.40–0.69)	0.55 (0.41–0.74)	■	
Sensitivity #1	45/130 (34.6)	1744/3565 (48.9)	0.59 (0.45–0.77)	0.61 (0.46–0.82)	■	
Sensitivity #2	45/130 (34.6)	127/260 (48.9)	0.52 (0.38–0.72)	0.49 (0.34–0.71)	■	
Sensitivity #3	27/77 (35.1)	494/1032 (47.9)	0.56 (0.39–0.80)	0.61 (0.43–0.89)	■	
PaO₂/FiO₂ <80 mm Hg						
	35/95 (36.8)	1036/1922 (53.9)	0.50 (0.37–0.68)	0.55 (0.40–0.77)	■	
PaO₂/FiO₂ <150 mm Hg						
	49/149 (32.9)	3178/7502 (42.4)	0.56 (0.43–0.73)	0.55 (0.42–0.73)	■	

0.0 0.5 1.0 1.5

Adjusted HR (95% CI)

Bénéfice certain dans une population
 de SDRA sévère hypoxique

Survival benefit of extracorporeal membrane oxygenation in severe COVID-19: a multi-centre-matched cohort study



Abstract

Purpose: Extracorporeal membrane oxygenation (ECMO) has become an established therapy for severe respiratory failure in coronavirus disease 2019 (COVID-19). The added benefit of receiving ECMO in COVID-19 remains uncertain. The aim of this study is to analyse the impact of receiving ECMO at specialist centres on hospital mortality.

Methods: A multi-centre retrospective study was conducted in COVID-19 patients from 111 hospitals, referred to two specialist ECMO centres in the United Kingdom (UK) (March 2020 to February 2021). Detailed covariate data were contemporaneously curated from electronic referral systems. We analysed added benefit of ECMO treatment in specialist centres using propensity score matching techniques.

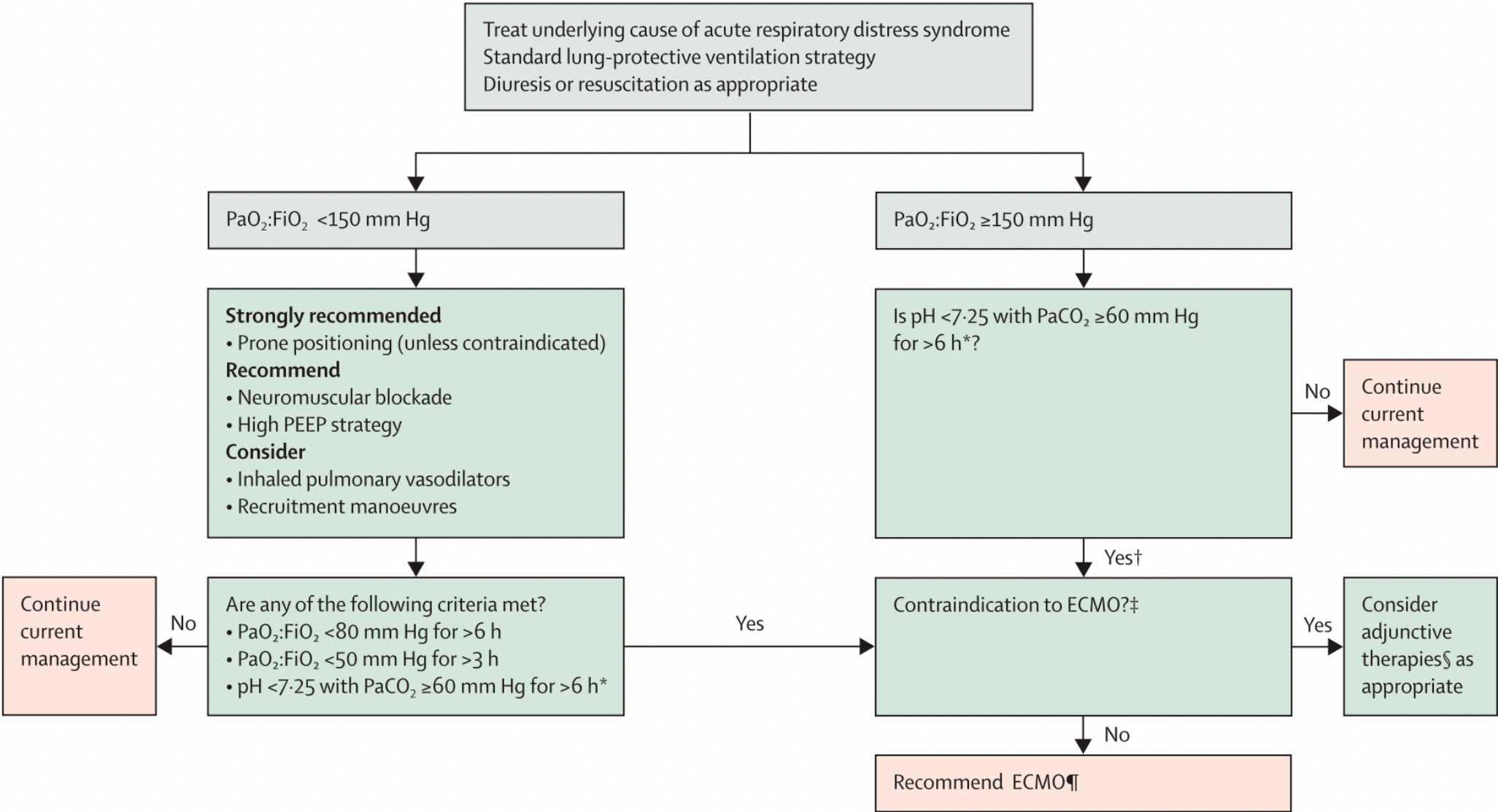
Results: 1363 patients, 243 receiving ECMO, were analysed. The best matching technique generated 209 matches, with a marginal odds ratio (OR) for mortality of 0.44 (95% CI 0.29–0.68, $p < 0.001$) and absolute mortality reduction of 18.2% (44% vs 25.8%, $p < 0.001$) for treatment with ECMO in a specialist centre.

Conclusion: We found ECMO provided at specialist centres conferred significant survival benefit. Where resources and specialism allow, ECMO should be widely offered.

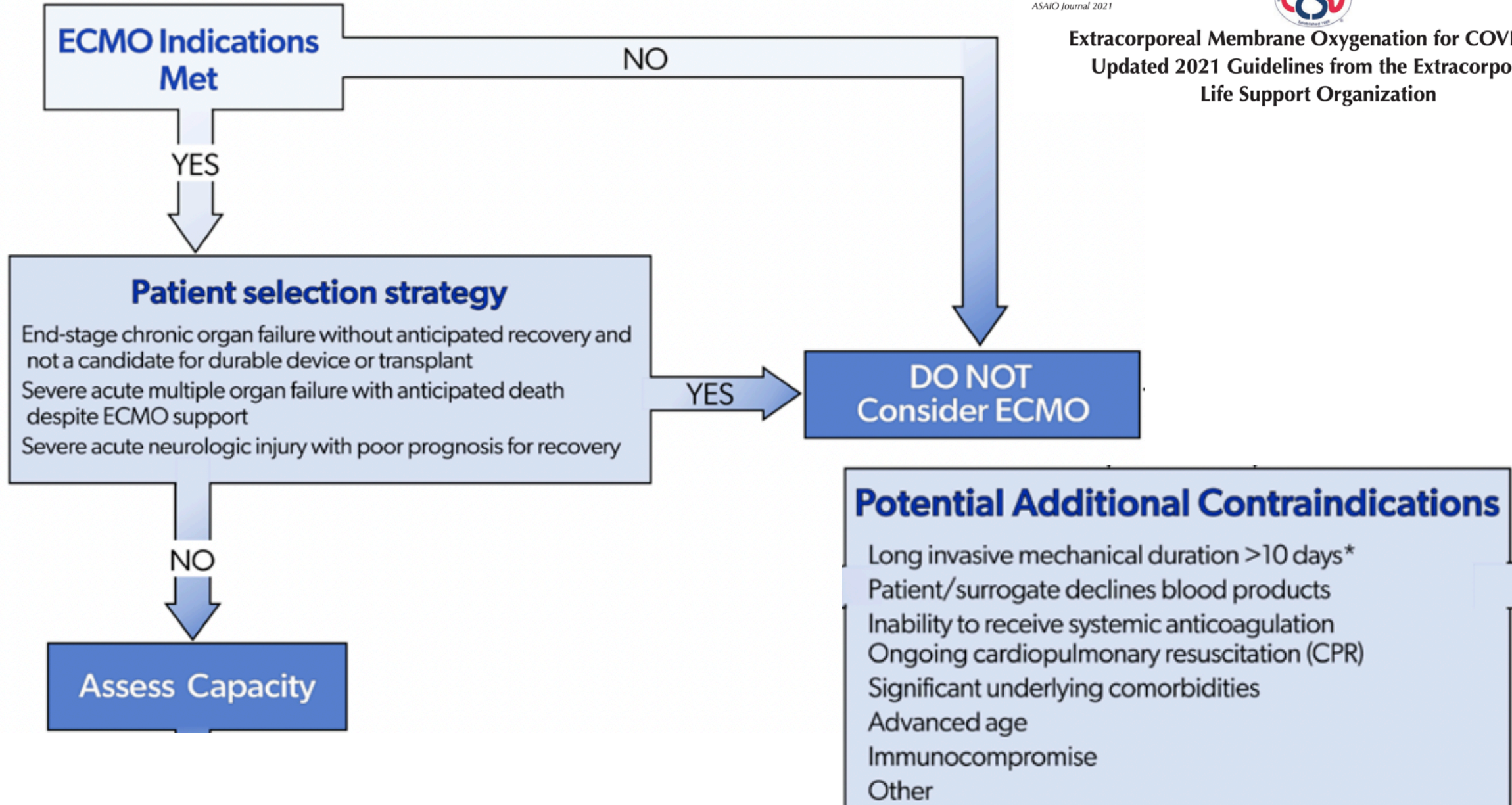
Keywords: ECMO, COVID-19, ARDS, Severe respiratory failure



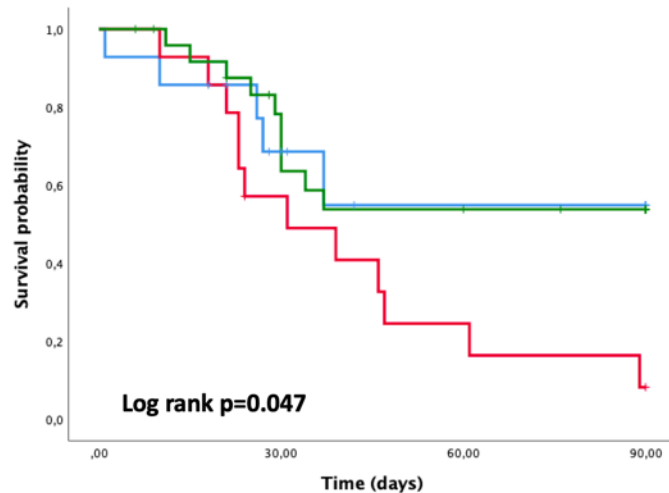
Extracorporeal Membrane Oxygenation for COVID-19: Updated 2021 Guidelines from the Extracorporeal Life Support Organization



Extracorporeal Membrane Oxygenation for COVID-19: Updated 2021 Guidelines from the Extracorporeal Life Support Organization



Surmortalité de la 2ème vague sous ECMO



Increasing Mortality in Venovenous Extracorporeal Membrane Oxygenation for COVID-19–Associated Acute Respiratory Distress Syndrome

Braaten, Jacob A. BS¹; Bergman, Zachary R. MD²; Wothe, Jillian K. BS²; Lofrano, Arianna E. DO⁴; Matze Luke J. MD⁵; Doucette, Melissa RRT, CCP⁶; Saavedra-Romero, Ramiro MD⁶; Bohman, John K. MD⁵; Prekker, Matthew E. MD, MPH^{3,4}; Luszczek, Elizabeth R. PhD²; Brunsvold, Melissa E. MD, FACS²

[Author Information](#)

Critical Care Explorations: March 2022 - Volume 4 - Issue 3 - p e0655
doi: 10.1097/CCE.0000000000000655

Extracorporeal membrane oxygenation for COVID-19 during first and second waves

Lars Mikael Broman • Staffan Eksborg • Valeria Lo Coco • Maria Elena De Piero • Jan Belohlavek • Roberto Lorusso • et al. [Show all authors](#)

Published: June 16, 2021 • DOI: [https://doi.org/10.1016/S2213-2600\(21\)00262-9](https://doi.org/10.1016/S2213-2600(21)00262-9) [Check for updates](#)

Number of patients at risk				
First wave	14	10	9	9
Seconde wave	14	8	4	2
Third wave	26	20	16	16

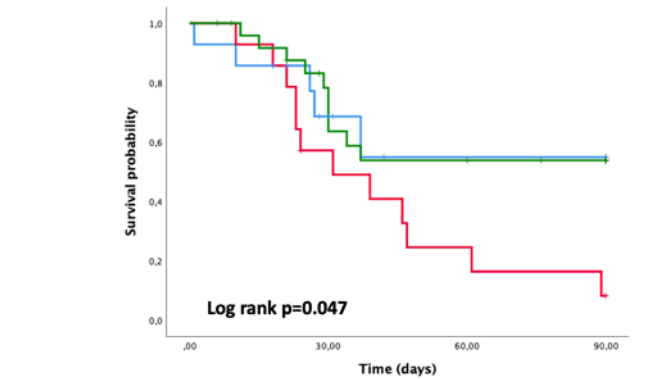
ASAIO under review

Mortalité
2ème vague

85 %

63 %

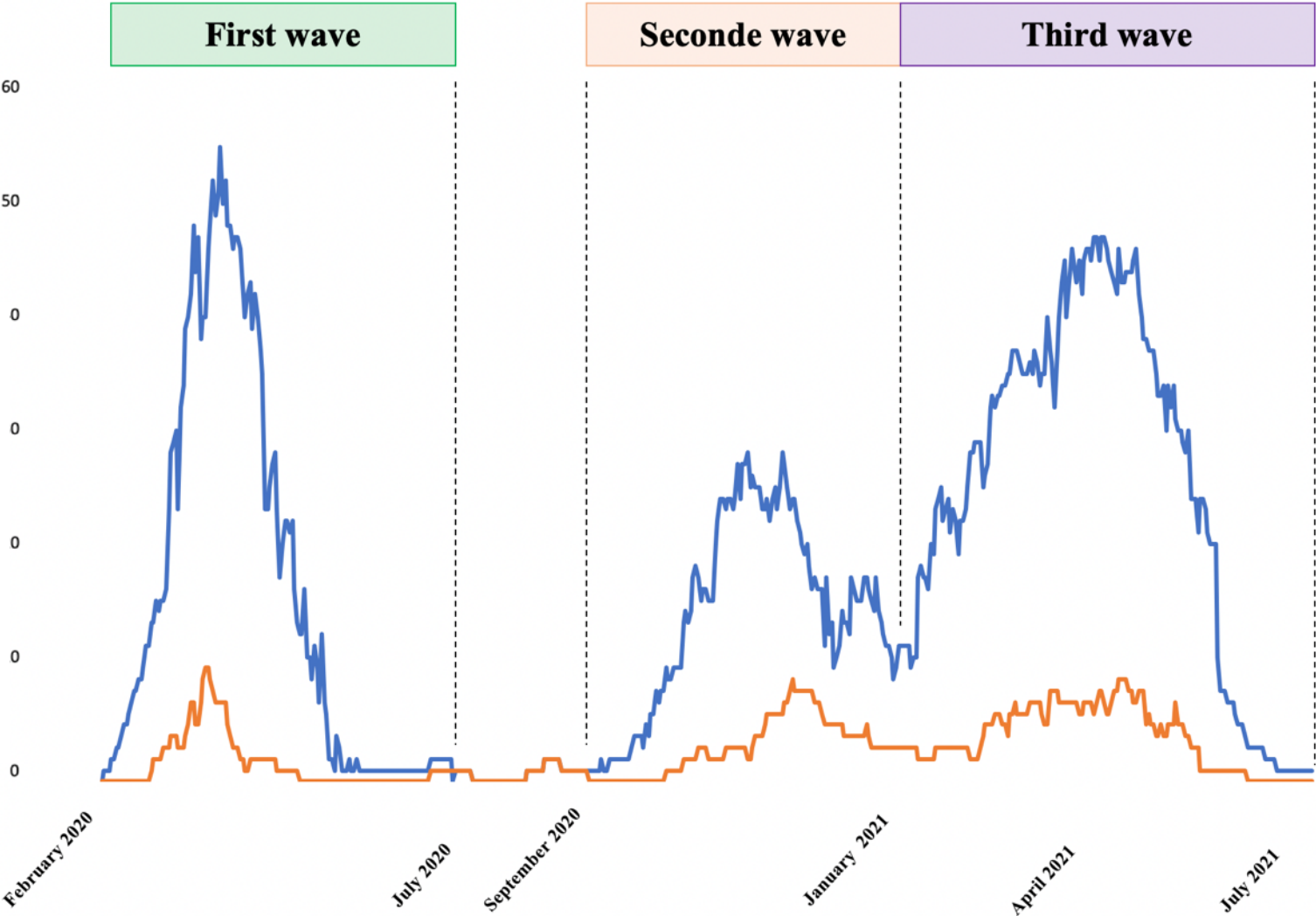
70 %

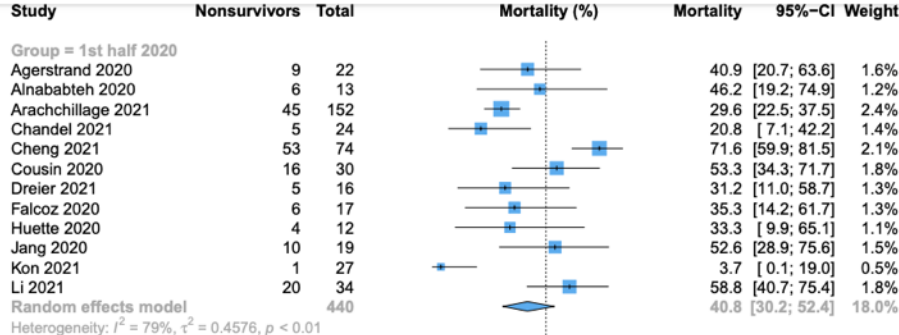


Number of patients at risk				
First wave	14	10	9	9
Seconde wave	14	8	4	2
Third wave	26	20	16	16

— COVID-19 patients

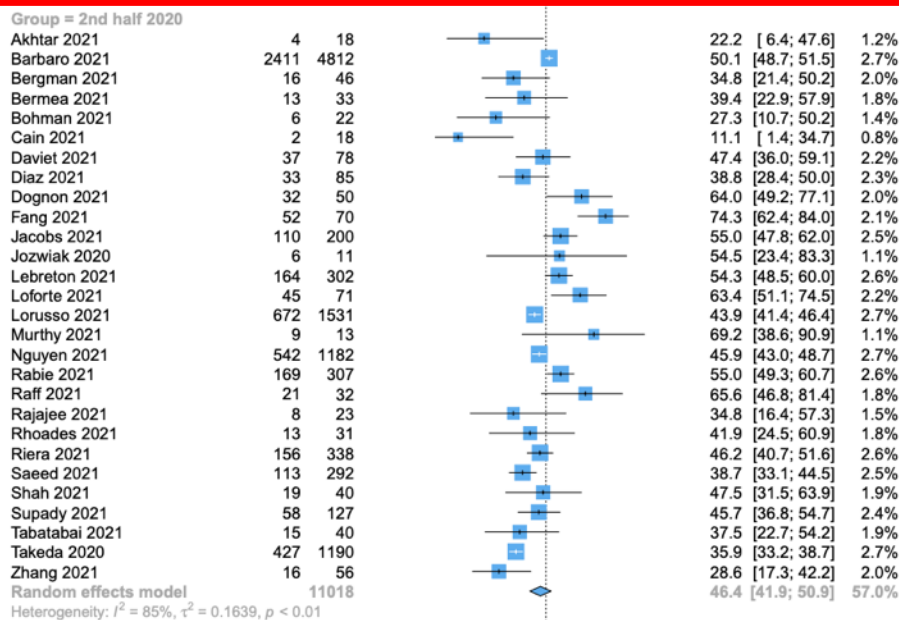
— COVID-19 patients with ECMO





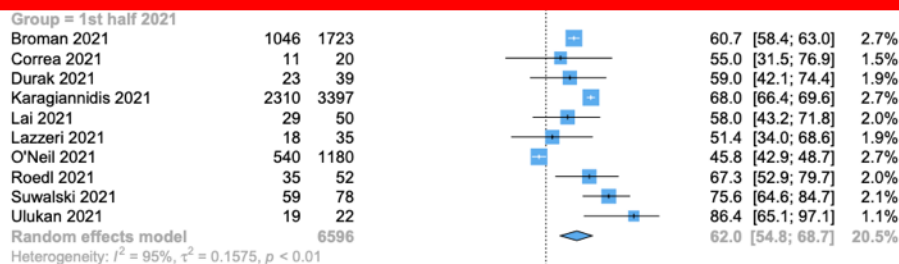
1^{ère} moitié de 2020

41 %



2^{ème} moitié de 2020

46 %



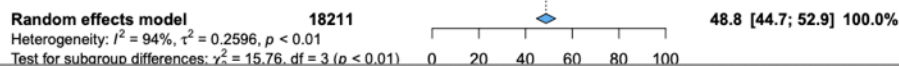
1^{ère} moitié de 2021

62 %



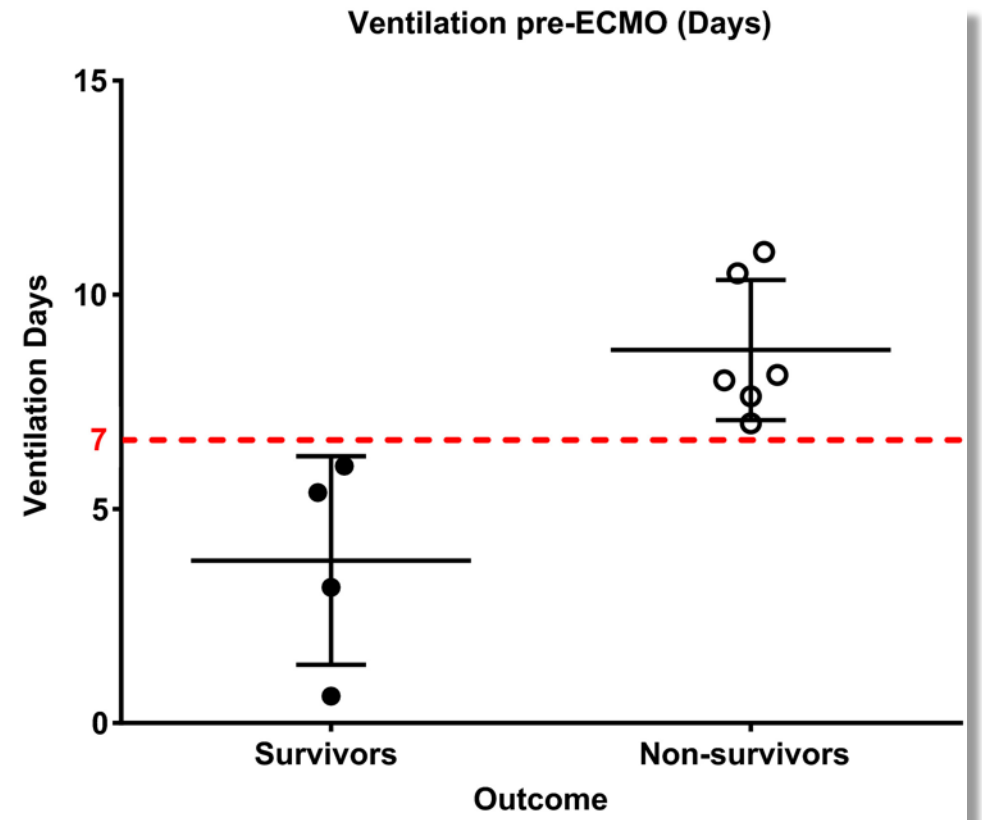
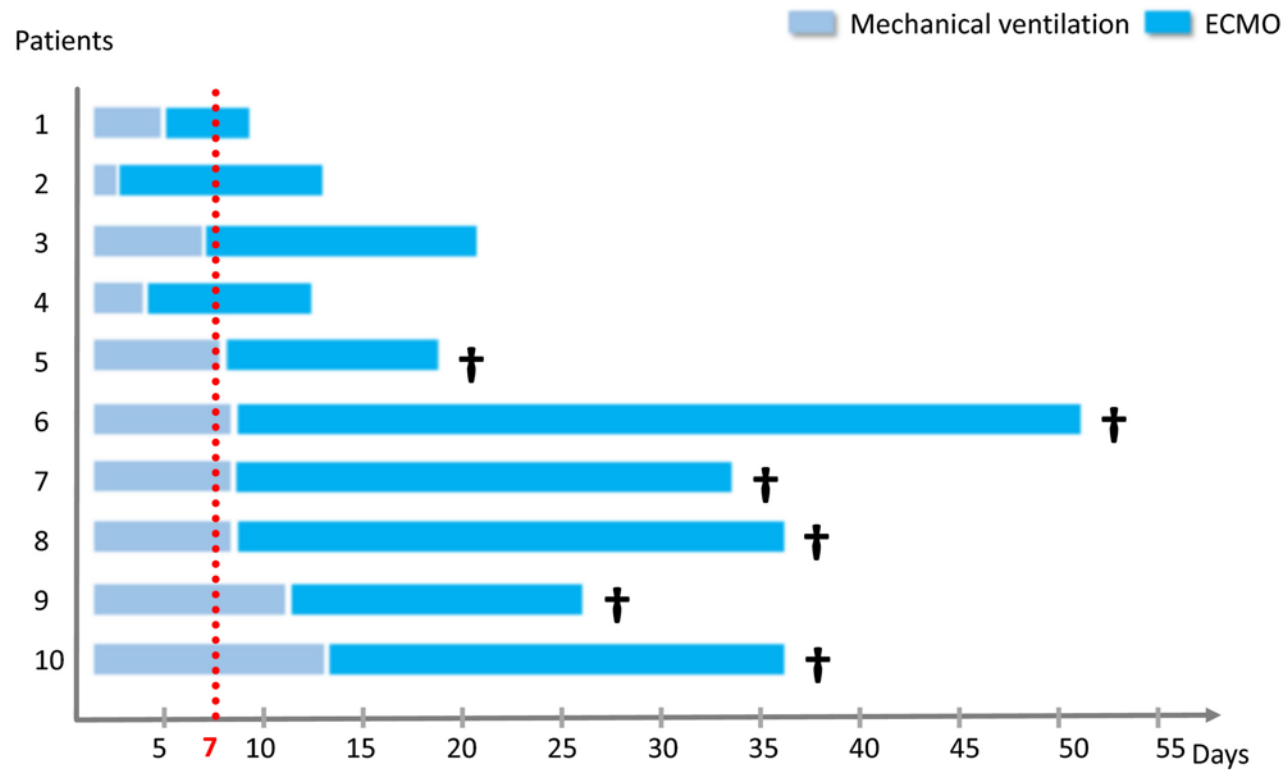
2^{ème} moitié de 2021

49%



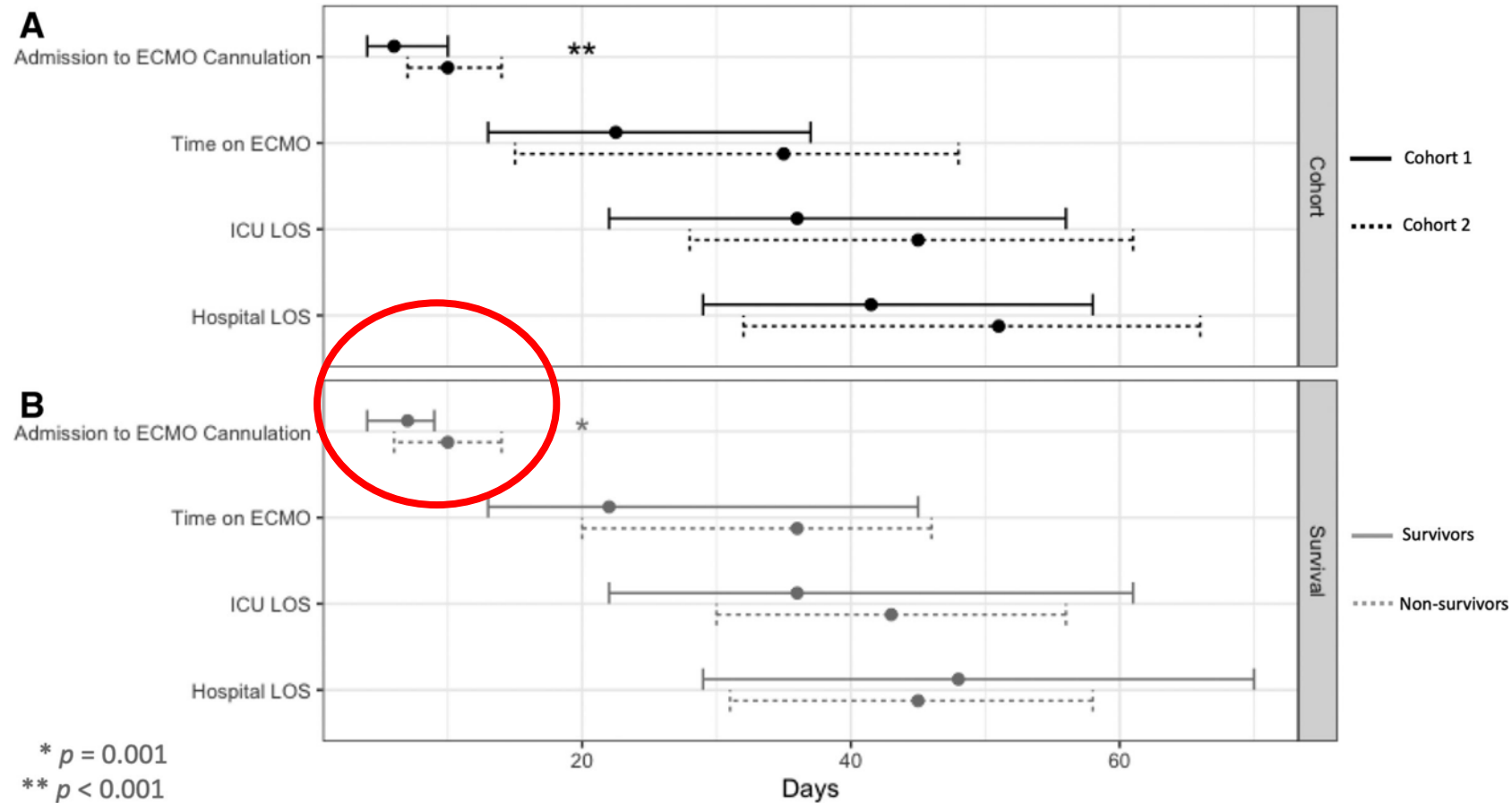
Délai avant ECMO

Timing of VV-ECMO therapy implementation influences prognosis of COVID-19 patients



4 ± 2 days vs. 9 ± 2 days, $p = 0.01$ (survivors vs non-survivors)

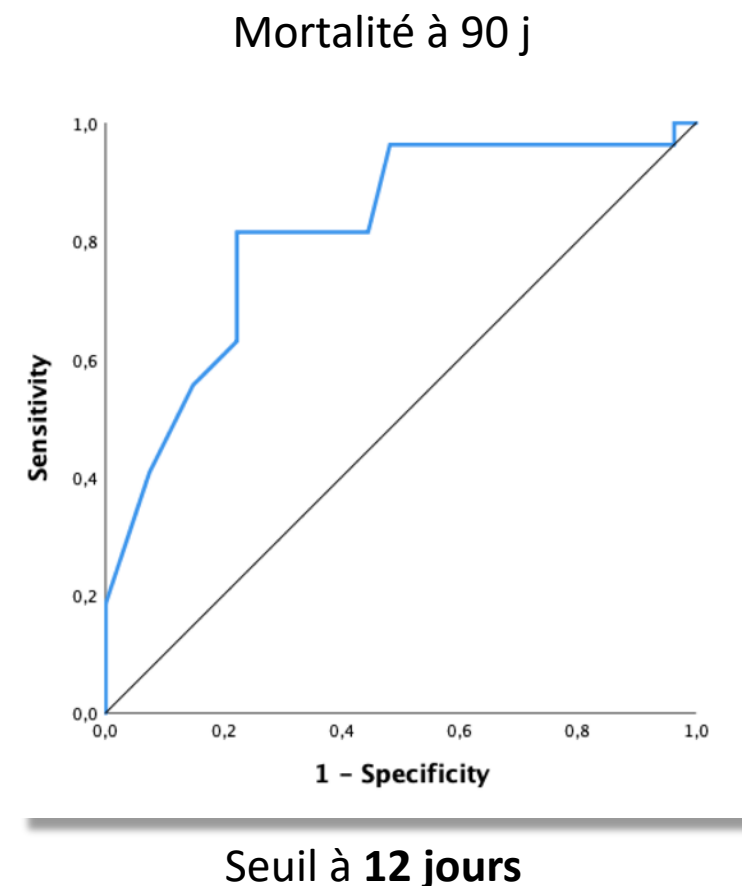
Délai admission/ECMO prolongé



7 vs 10 days, P=0.001

Délai symptômes/ECMO

Variables	90 days mortality			
	Univariate analysis		Multivariate analysis	
	HR (95%CI)	P	HR (95%CI)	P
Age > 60 years	3.52 1.52-8.1	0.003	3.36 1.43-9.1	0.006
Modified RESP score (for each point)	0.72 0.56-0.91	0.007	0.75 (0.57-0.98)	0.044
Lung compliance before ECMO	0.96 (0.92-1.01)	0.12	-	
Time to first symptoms to ECMO (for each day)	1.12 1.05-1.19	0.001	1.10 1.02-1.17	0.013
Prone positioning	1.14 0.39-3.31	0.811		
Epidemic waves	-	-	-	-
• First wave	-	-	-	-
• Second wave	2.9 1.2-6.9	0.012	1.29 0.51-3.27	0.58
• Third wave	1.07 0.41-2.7	0.88	-	-
SOFA score	1.9 0.91-4.1	0.08	-	-
Vasopressor use before ECMO support	1.5 0.71-3.2	0.29	-	-



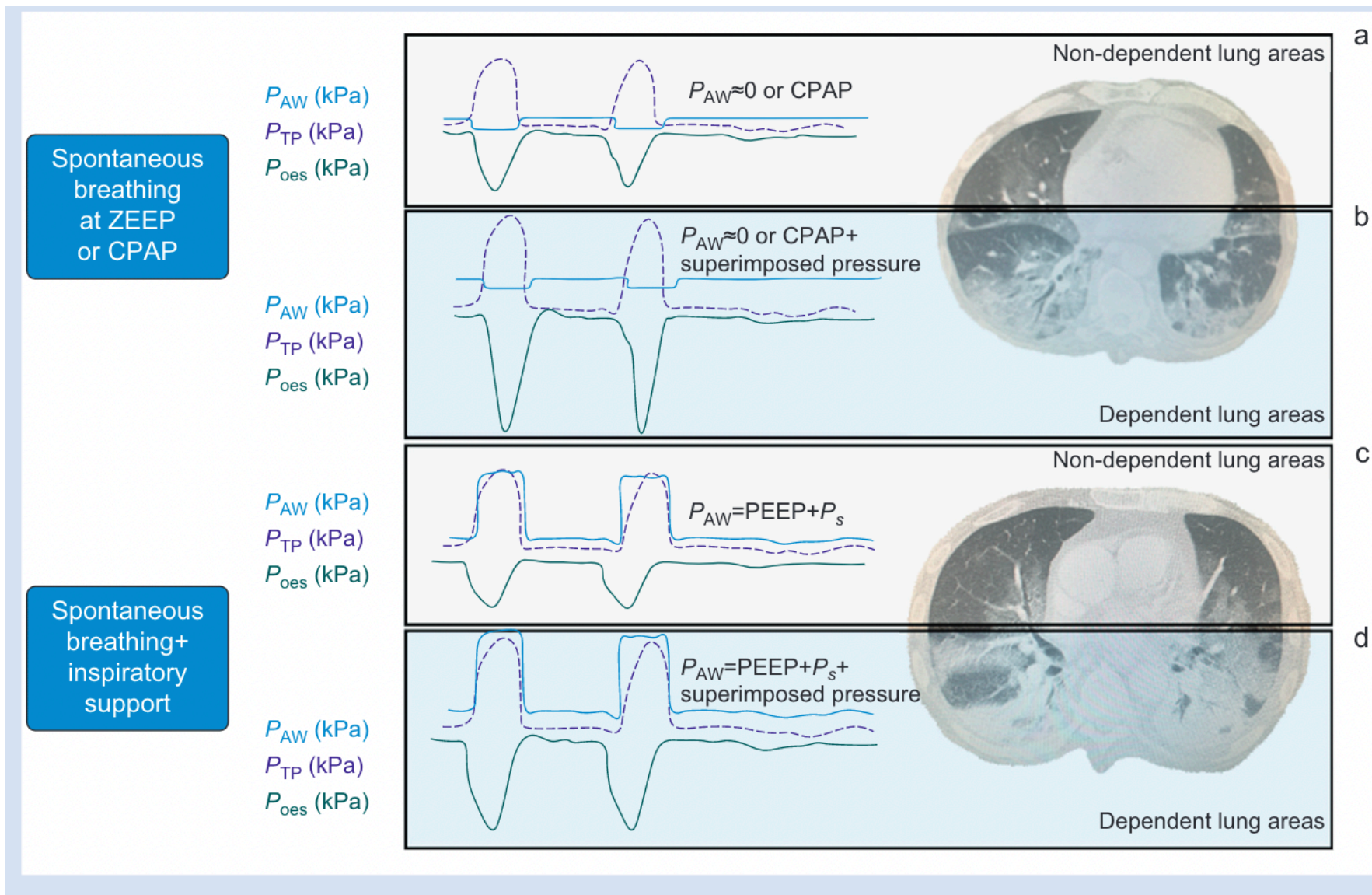
Délai d'intubation=HFNO

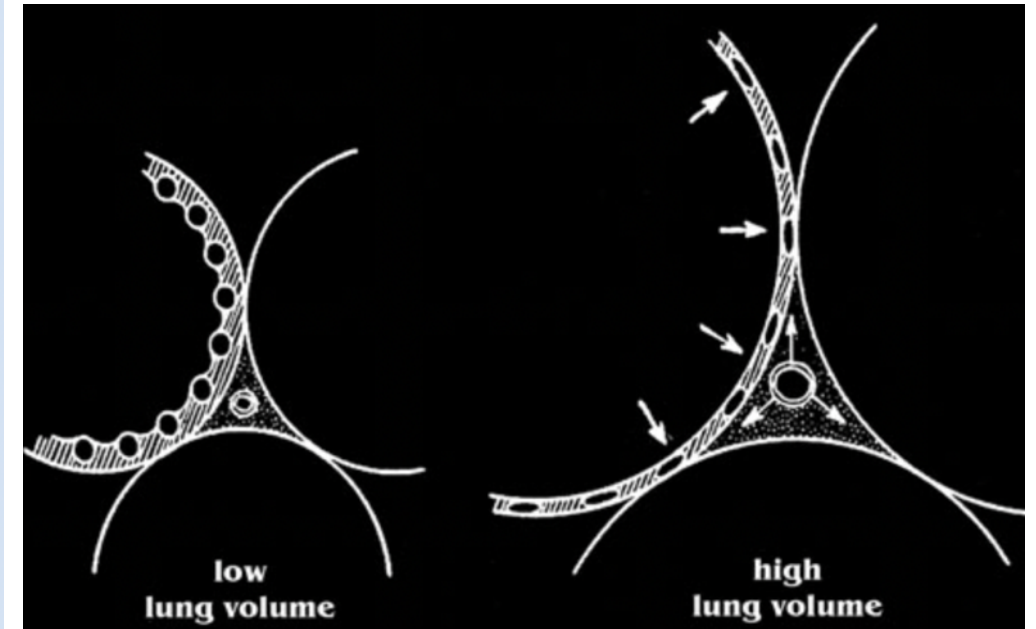
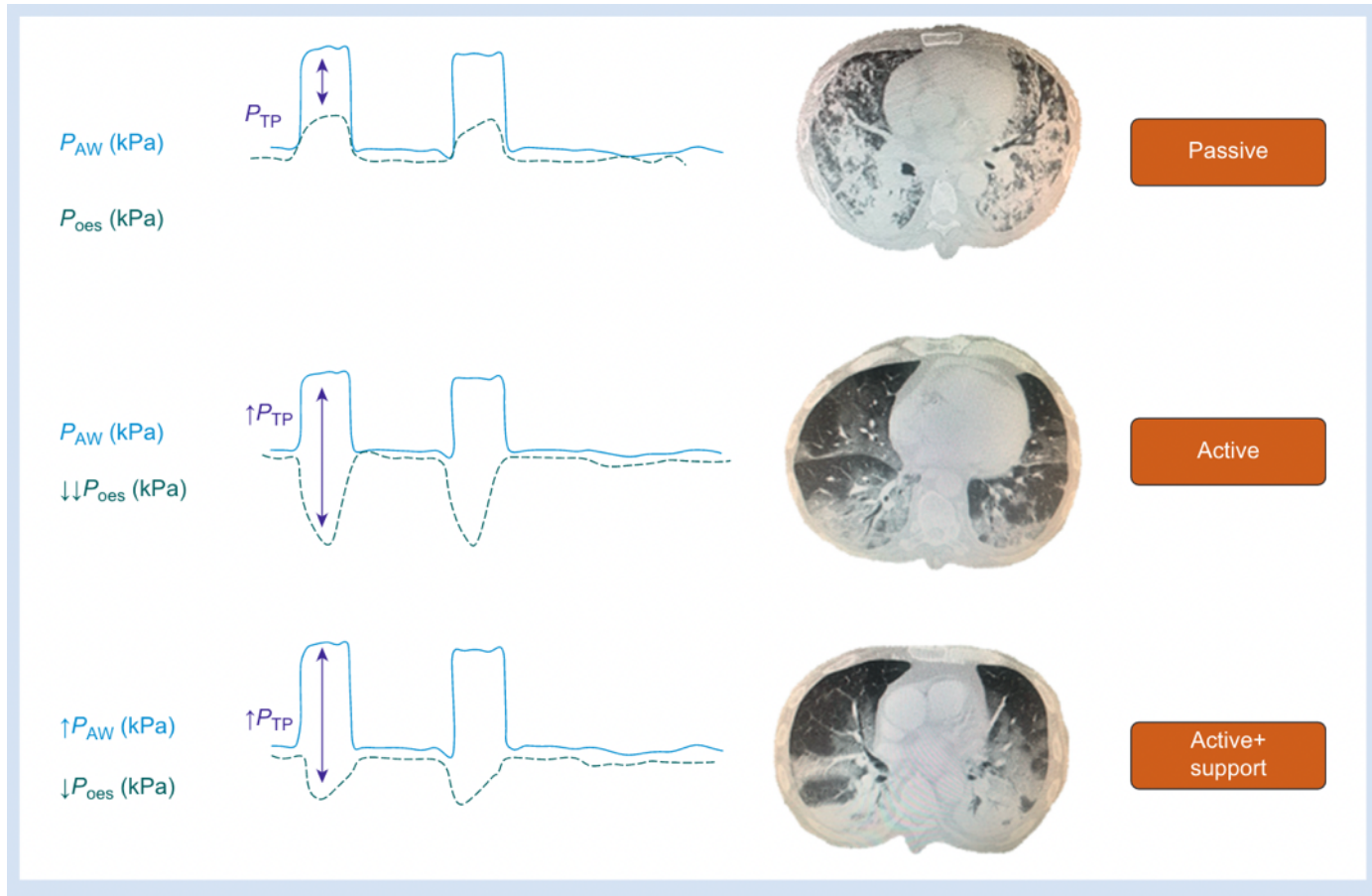


	Group A1	Group A2	Group B	p value: A1 vs A2	p value: A2 vs B
Pre-intubation non-invasive ventilation*	689 (58%)	2139 (76%)	564 (70%)	<0.001	0.16
Bilevel positive airway pressure	202 (17%)	939 (33%)	313 (39%)	<0.001	0.18
Continuous positive airway pressure	158 (13%)	385 (14%)	73 (9%)	1.00	0.19
High-flow nasal cannula	420 (36%)	1463 (52%)	341 (42%)	<0.001	0.036
More than one non-invasive support	83 (7%)	592 (21%)	151 (19%)	<0.001	0.47

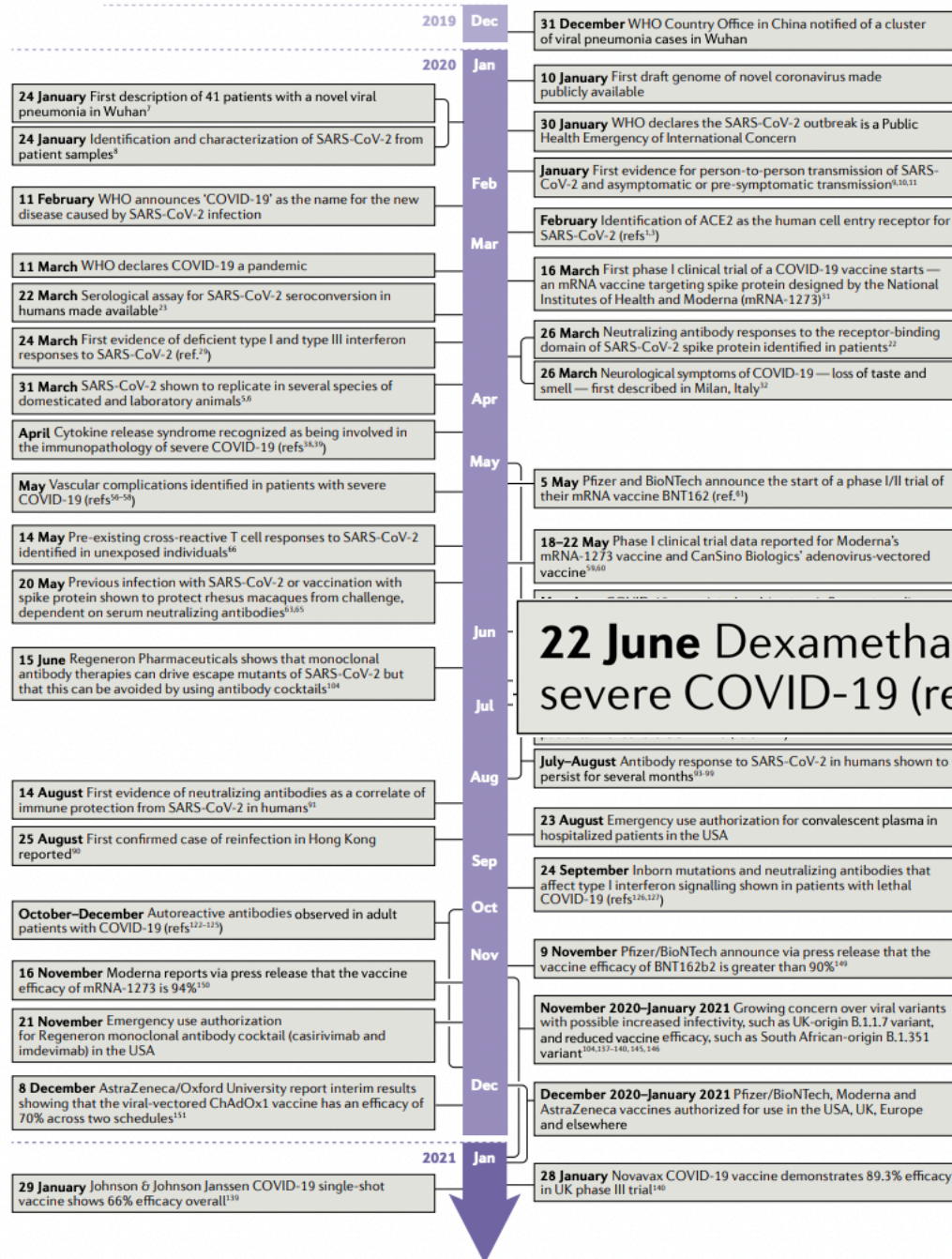
Noninvasive respiratory support and patient self-inflicted lung injury in COVID-19: a narrative review

Denise Battaglini^{1,2}, Chiara Robba^{1,3}, Lorenzo Ball^{1,3}, Pedro L. Silva^{4,5}, Fernanda F. Cruz^{4,5}, Paolo Pelosi^{1,3} and Patricia R. M. Rocco^{4,5,*}





Marini JJ, Crit Care 2003

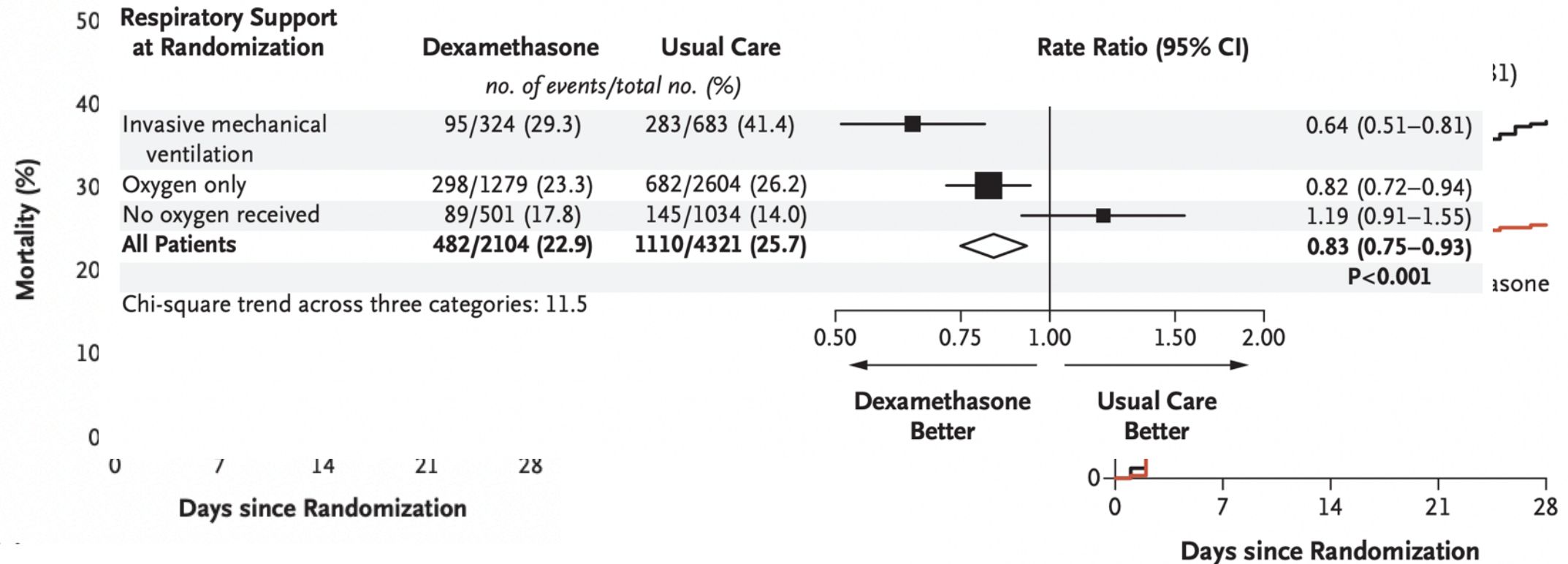


ORIGINAL ARTICLE

Dexamethasone in Hospitalized Patients with Covid-19 — Preliminary Report

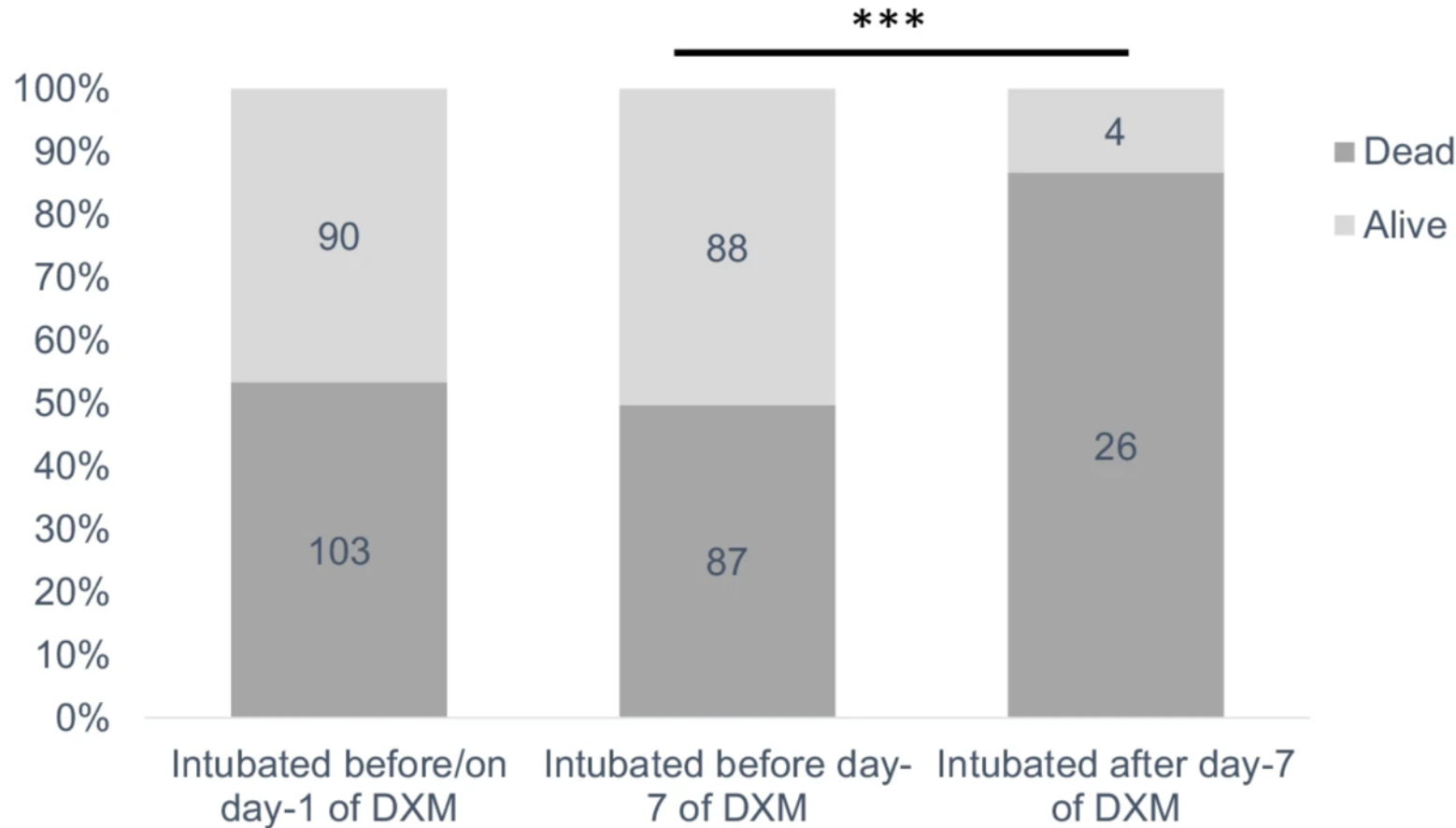
The RECOVERY Collaborative Group*

All Participants (N=6475)



Résistance aux corticoïdes

Very late intubation in COVID-19 patients: a forgotten prognosis factor?



Perte de chance au-delà de 7j
d'une détresse
respiratoire

Pour intuber

THE LANCET

ISSN 0140-6736

Defeating AIDS—advancing global health



"The question is no longer whether the fight against AIDS can be won: the only questions are: will it be soon—and when?"

By *David R. Brown* and *John W. Hens*

Commentary	Editorial	Research	Reviews	Special Reports
Defeating AIDS—advancing global health David R. Brown and John W. Hens	Editorial AIDS: the end of the beginning	Research AIDS: the end of the beginning	Reviews AIDS: the end of the beginning	Special Reports AIDS: the end of the beginning

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Survie à 90 j

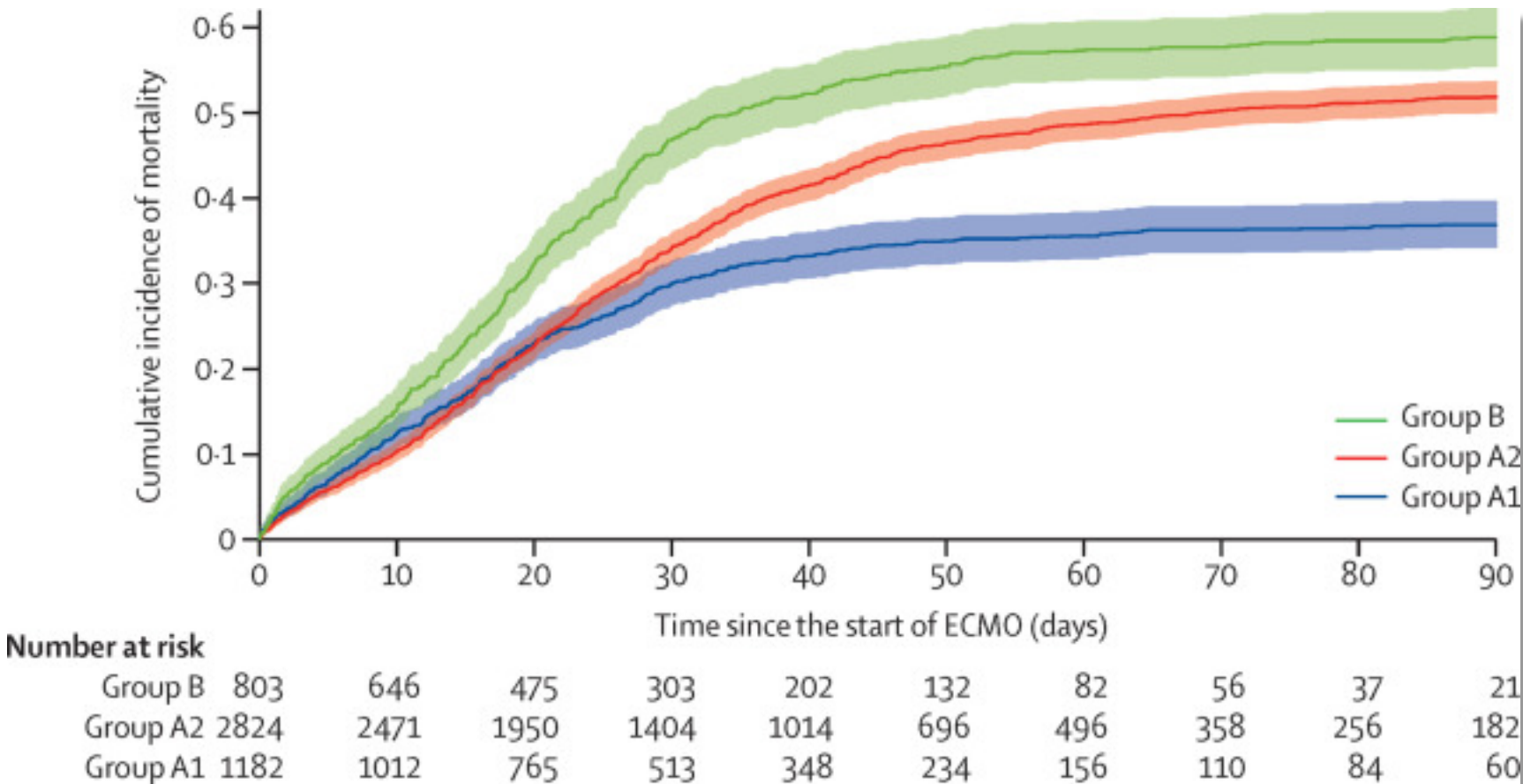
Extracorporeal membrane oxygenation for COVID-19: evolving outcomes from the international Extracorporeal Life Support Organization Registry

Ryan P Barbaro*, Graeme MacLaren*, Philip S Boonstra, Alain Combes, Cara Agerstrand, Gail Annich, Rodrigo Diaz, Eddy Fan, Katarzyna Hryniewicz, Roberto Lorusso, Matthew L Paden, Christine M Stead, Justyna Swol, Theodore J Iwashyna†, Arthur S Slutsky†, Daniel Brodie†, for the Extracorporeal Life Support Organization



Cohorte ELSO de 4812 patients

- Group A1** patients started ECMO on or before May 1, 2020, at early-adopting centres.
- Group A2** patients started ECMO between May 2 and Dec 31, 2020, at early-adopting centres.
- Group B** patients received ECMO at late-adopting centres, which only provided ECMO for COVID-19 after May 1, 2020



Indications ECMO/CARDS

$\text{PaO}_2/\text{FiO}_2 < 100$
Et/ou
Acidose respiratoire $\text{pH} < 7,25$
malgré
2 séances de DV de 16 h
Curarisation
Ventilation protectrice et haute PEEP
+/- recrutement

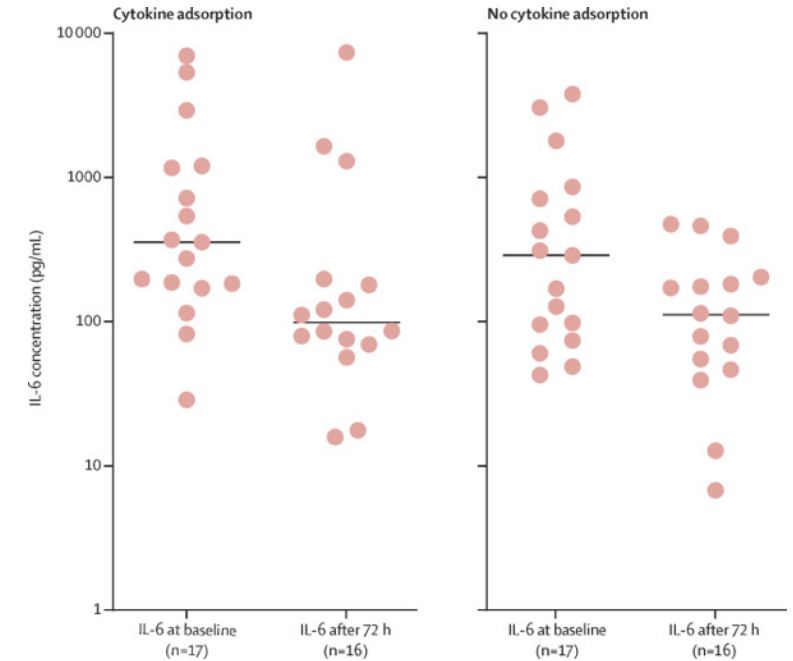
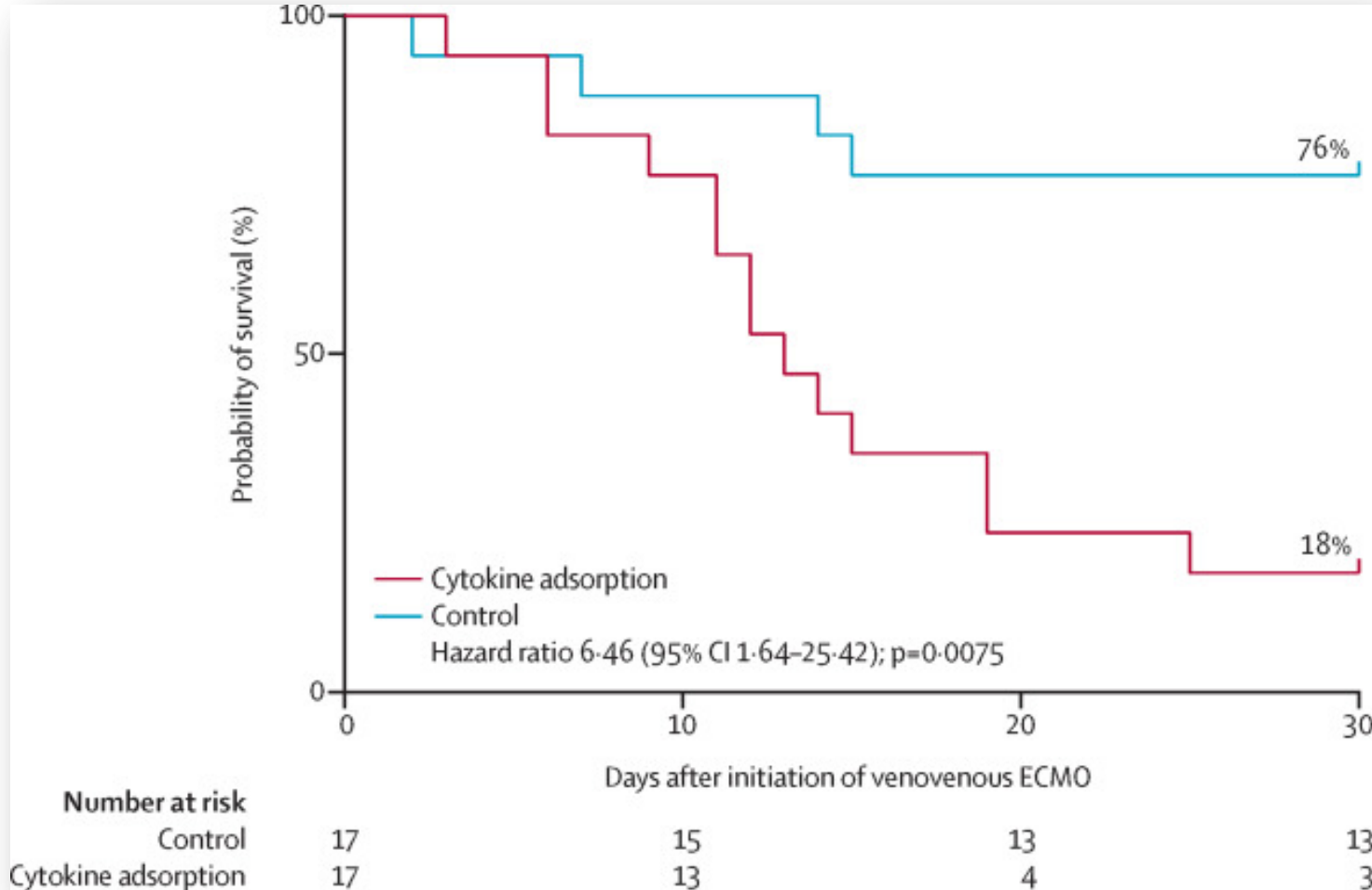


Age > 70 ans
Ventilation > 10 jours
symptômes > 15 jours (malgré TTT)
Défaillance multi viscérale
Comorbidités des patients
Autonomie à domicile

Discussion multidisciplinaire
pour chaque cas

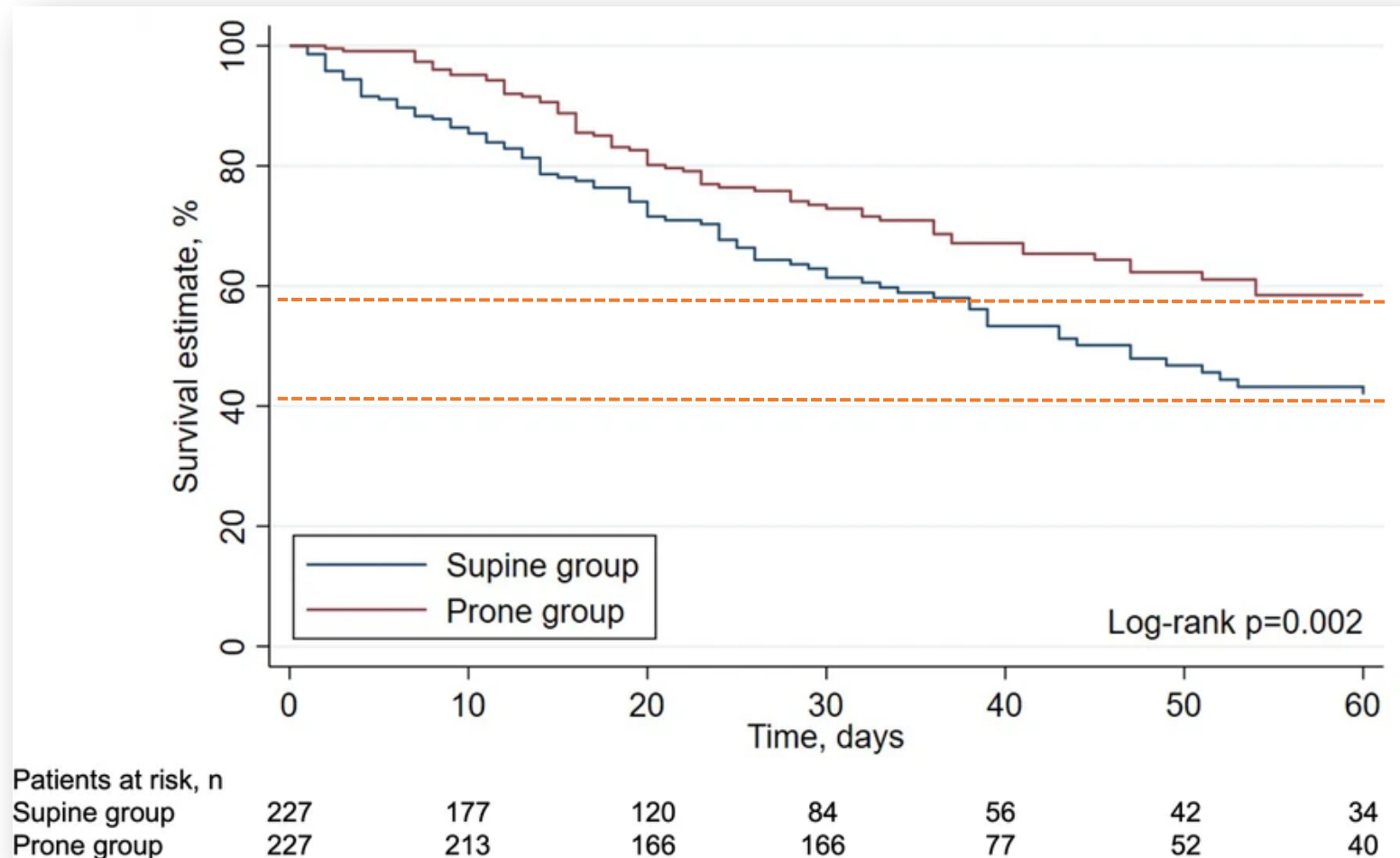
Mesures adjuvantes

Cytokine adsorption in patients with severe COVID-19 pneumonia requiring extracorporeal membrane oxygenation (CYCOV): a single centre, open-label, randomized, controlled trial



Faible effetif
Objectif d'IL 6 adapté?

Prone positioning during venovenous extracorporeal membrane oxygenation for acute respiratory distress syndrome: a pooled individual patient data analysis



Données individuelles pour 889 ECMO
227 patients matchés

HR=0.44 95%CI 0.29-0.68

*Bénéfice du DV chez les patients sous
ECMO*

Synthèse de l'ELSO

Mobile ECMO is feasible and may be conducted safely for patients with COVID-19.

Organize ECMO centers within geographic regions to coordinate patient referrals, where feasible.

Unify patient selection criteria across a geographic region, where feasible.

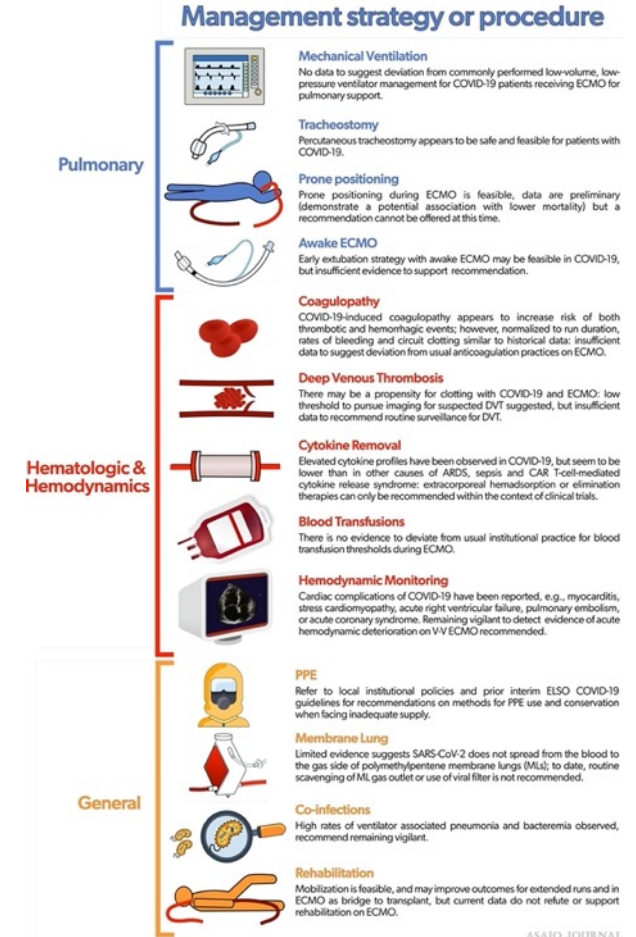
Contraindications for ECMO use should become more stringent as ECMO capacity diminishes.

Data submission to facilitate research is essential for our evolving understanding of optimal ECMO care for patients with COVID-19.

While some centers have increased their anticoagulation targets, bleeding remains a concern, and there is no data to recommend deviation from conventional anticoagulation goals.

There is no data to recommend deviation from conventional ECMO practices, *e.g.*, blood product transfusion thresholds, tracheostomy, endotracheal extubation, rehabilitation, cannulation configuration, or ventilator management.

Potential discontinuation of ECMO in the setting of perceived futility should be clearly discussed with patients and their surrogate decision-makers.



Messages

Bénéfice de l'ECMO dans le CARDS

Respect des contre-indications

Intérêt d'une ECMO dans les 7-10 jours quand échec d'une ventilation efficace

Considérer la durée d'évolution de la maladie

Monitoring et surveillance de l'anticoagulation

Soins standards pour un patient sous ECMO pour COVID-19

Merci à tous

