Effectiviteit en economische evaluatie van ECMO behandeling

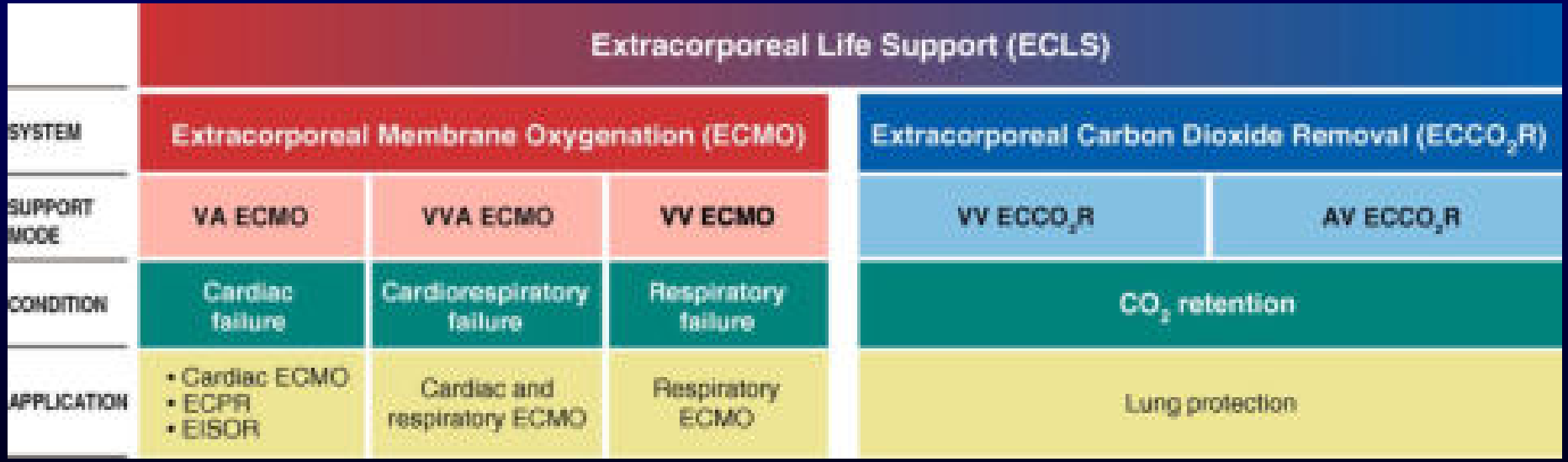
Walter van den Bergh

Intensive Care

Disclosure belangen spreker

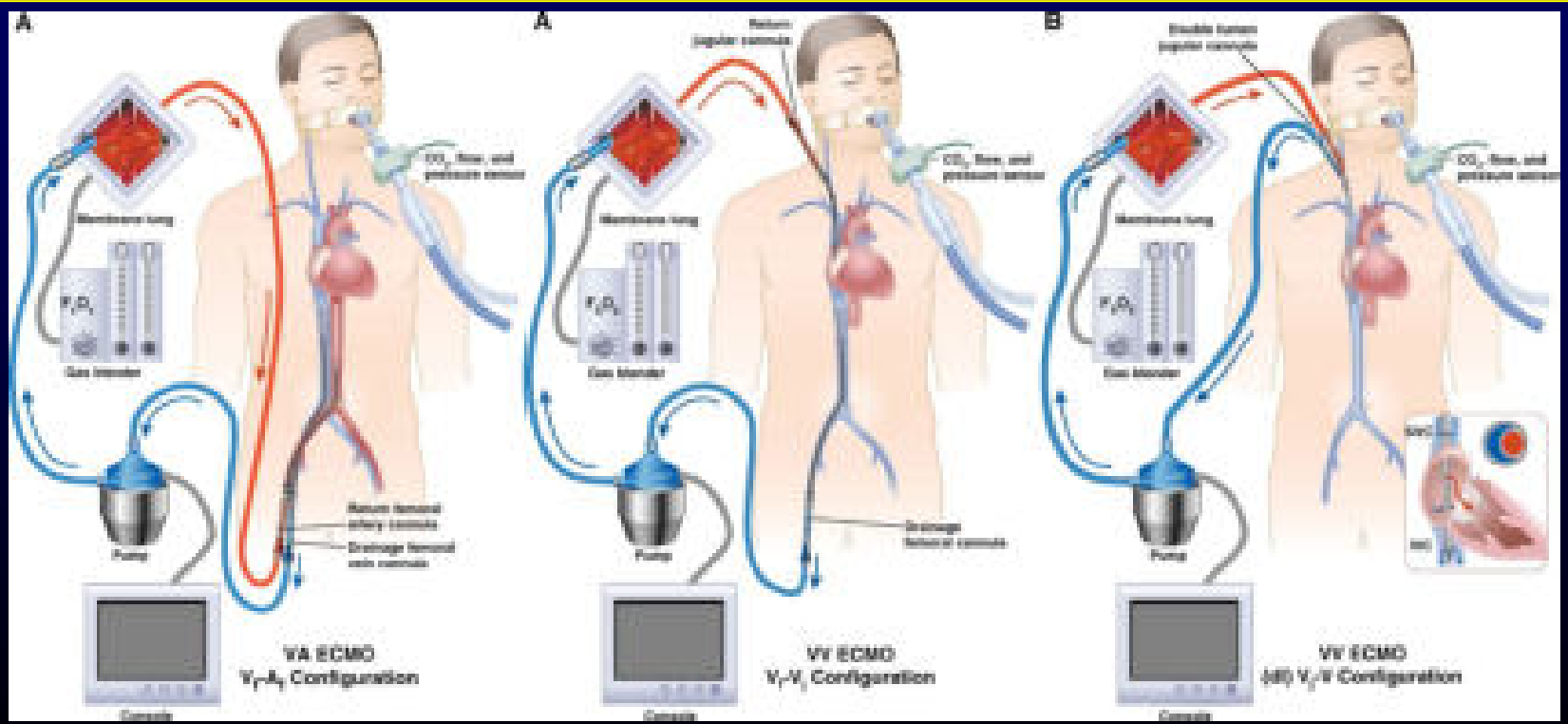
Geen (potentiële) belangenverstrengeling	
Voor bijeenkomst mogelijke relevante relaties	Bedrijfsnamen
• Sponsoring of onderzoeksgeld • Honorarium of andere (financiële) vergoeding • Aandeelhouder • Andere relatie, namelijk…	• ZonMw, Hartstichting, Hersenstichting • • •

ECLS/ECMO



Conrad SA, et al. The ELSO Maastricht Treaty for Nomenclature in ECLS. Am J Respir Crit Care Med. 2018

VA-ECMO & VV-ECMO



Effect + Kosten → kosteneffectiviteit

- VV-ECMO
  - ARDS
- VA-ECMO
  - post-cardiotomie shock / resuscitatie (eCPR)

- effect ECMO in RCT's → belang trial design
- kosten vooral observationele studies

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MAY 24, 2018 VOL. 378 NO. 21

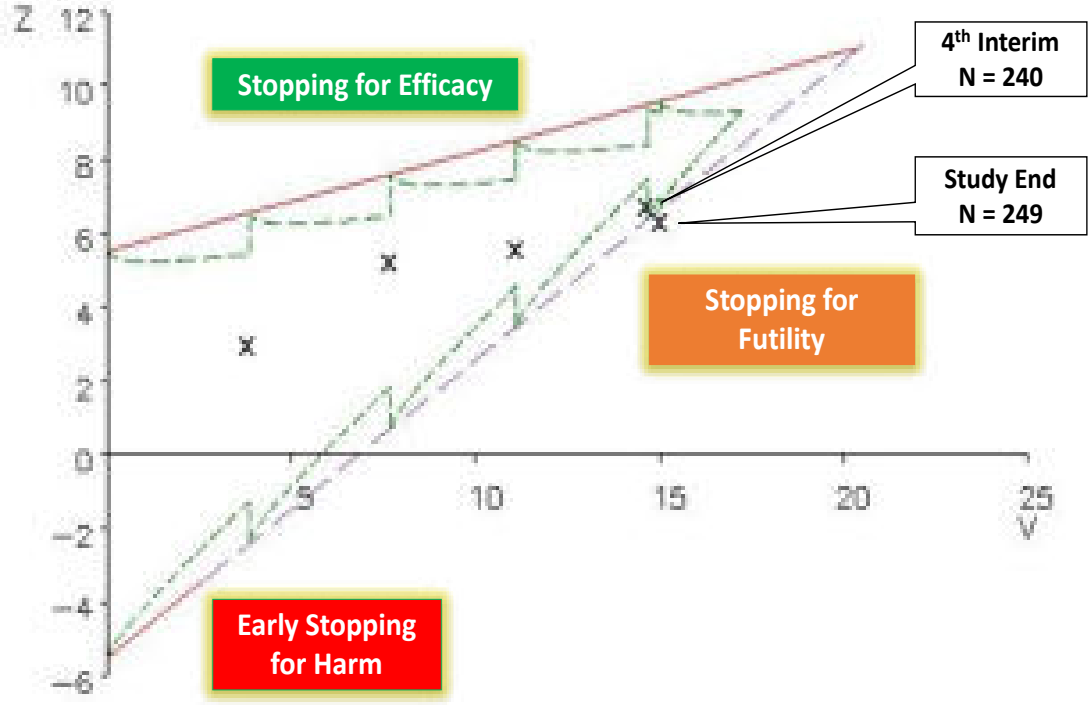
Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Distress Syndrome

A. Combes, D. Hajage, G. Capellier, A. Demoule, S. Lavoué, C. Guervilly, D. Da Silva, L. Zafrani, P. Tirot, B. Veber, E. Maury, B. Levy, Y. Cohen, C. Richard, P. Kalfon, L. Bouadma, H. Mehdaoui, G. Beduneau, G. Lebreton, L. Brochard, N.D. Ferguson, E. Fan, A.S. Slutsky, D. Brodie, and A. Mercat, for the EOLIA Trial Group, REVA, and ECMONet*

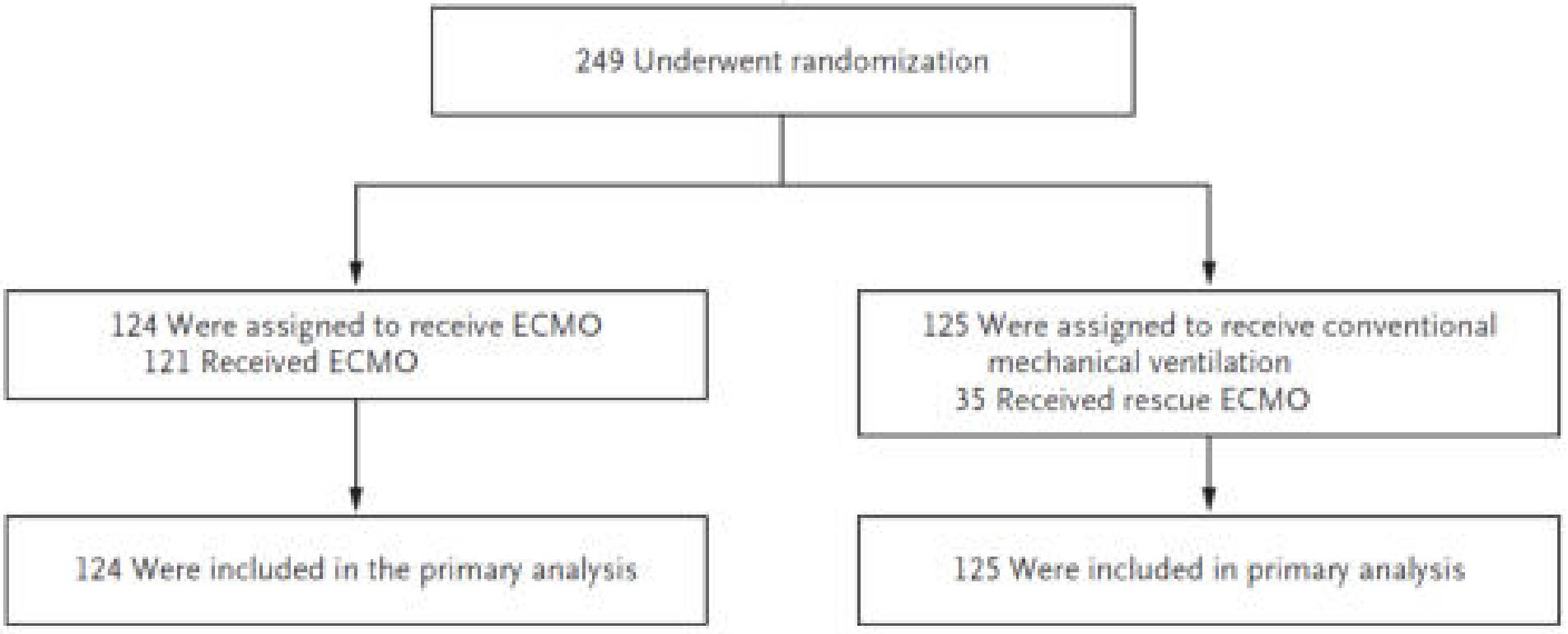
Methode

- severe ARDS
  - Pao_2 / Fio_2 ratio <50 mm Hg >3 hours
  - Pao_2 / Fio_2 ratio <80 mm Hg >6 hours
  - pH <7.2 >6h
  - buikligging, spierverslappers of NO
- sequentiele analyse na randomizatie van steeds 60 participants → stopping rules
- sample size 331

Patients

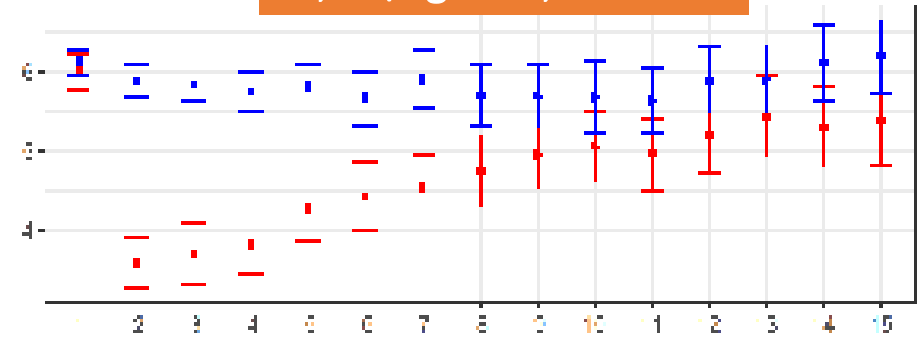


- Recruitment stopped
- At the 4th planned sequential interim analysis
  - 240 patients
  - April 2017
- Lower boundary of the stopping-rule triangle
  - Crossed
  - Predicting lack of difference

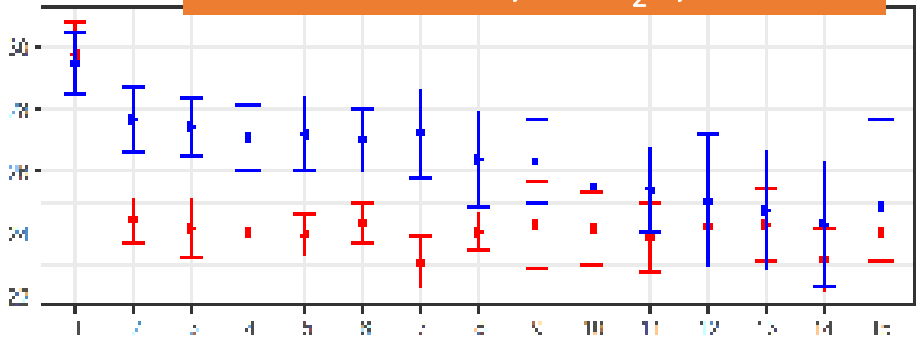

249 Underwent randomization
124 Were assigned to receive ECMO
121 Received ECMO
125 Were assigned to receive conventional mechanical ventilation
35 Received rescue ECMO
124 Were included in the primary analysis
125 Were included in primary analysis

ECMO Control

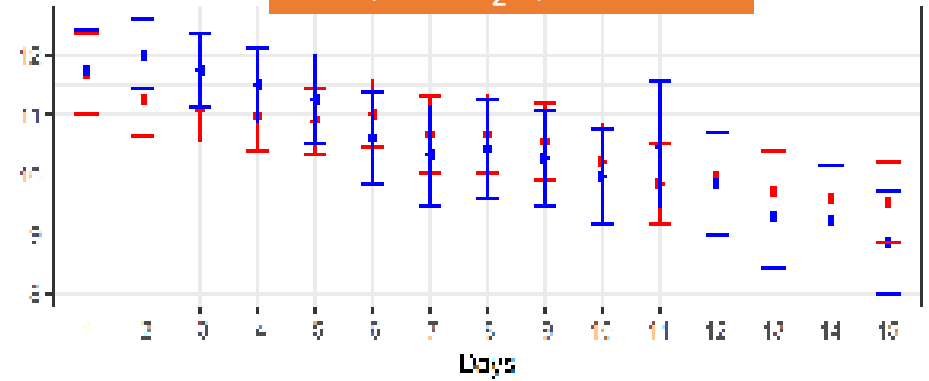
VT, ml/kg PBW, P <0.001



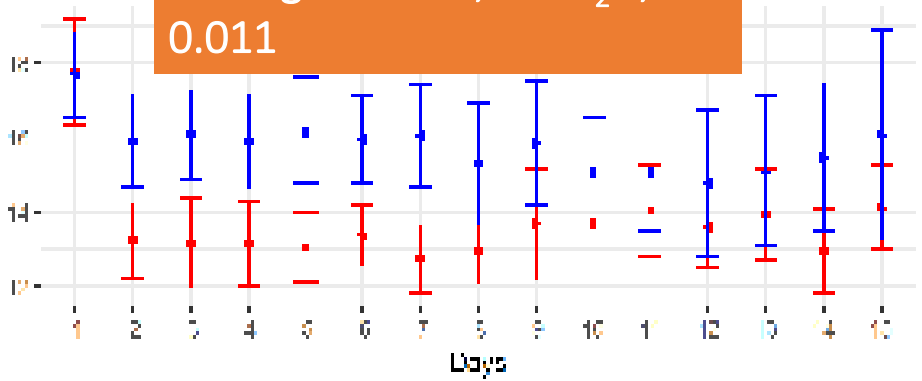
Plateau Pressure, cm H_2O, P <0.001



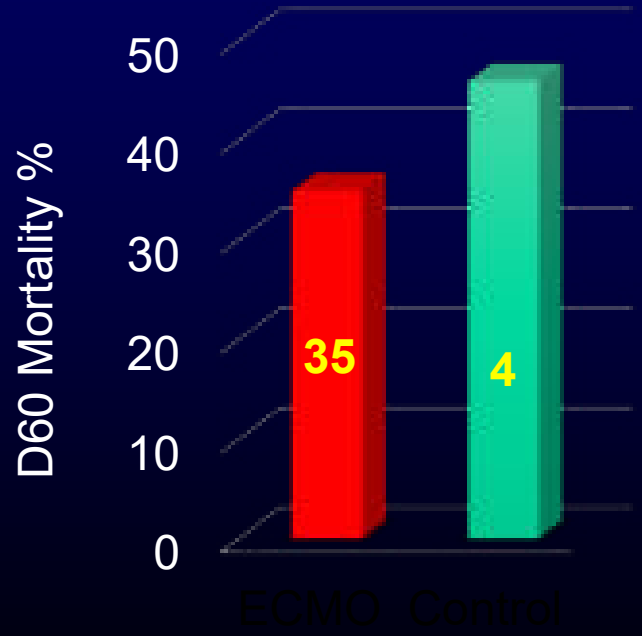
PEEP, cm H_2O, P = 0.291



Driving Pressure, cm H_2O, P = 0.011

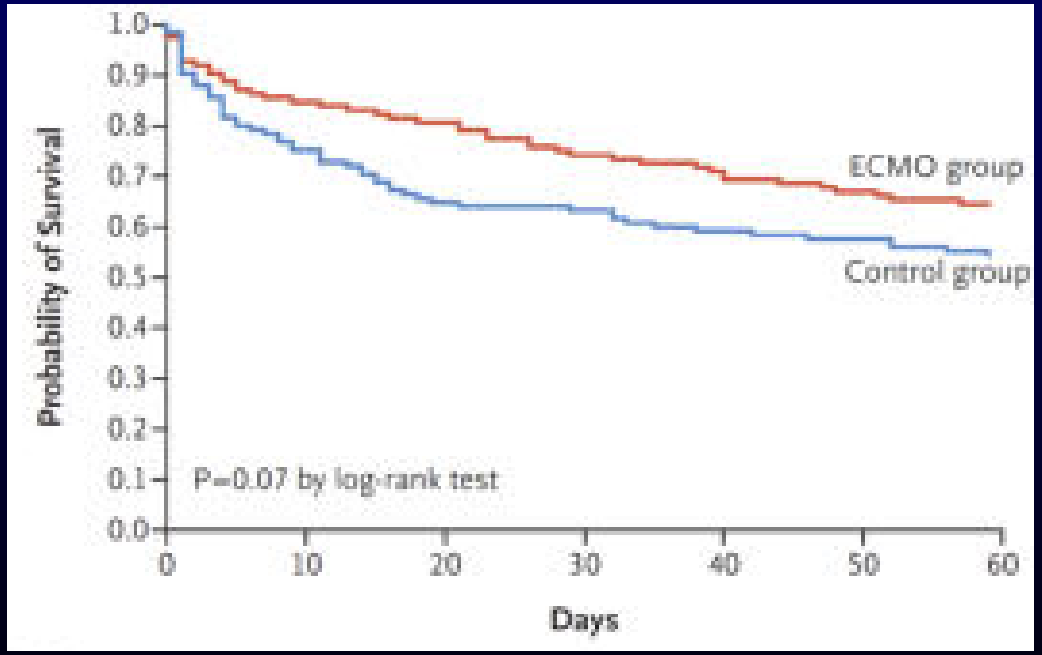


EOLIA results – dag 60 mort.



RR 0.76; 95%Cl 0.55-1.04; P=0.087

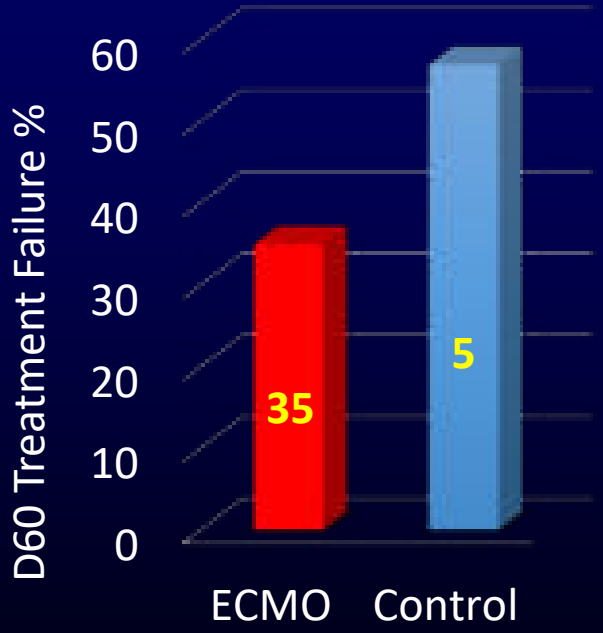
EOLIA results – dag 60 mort.



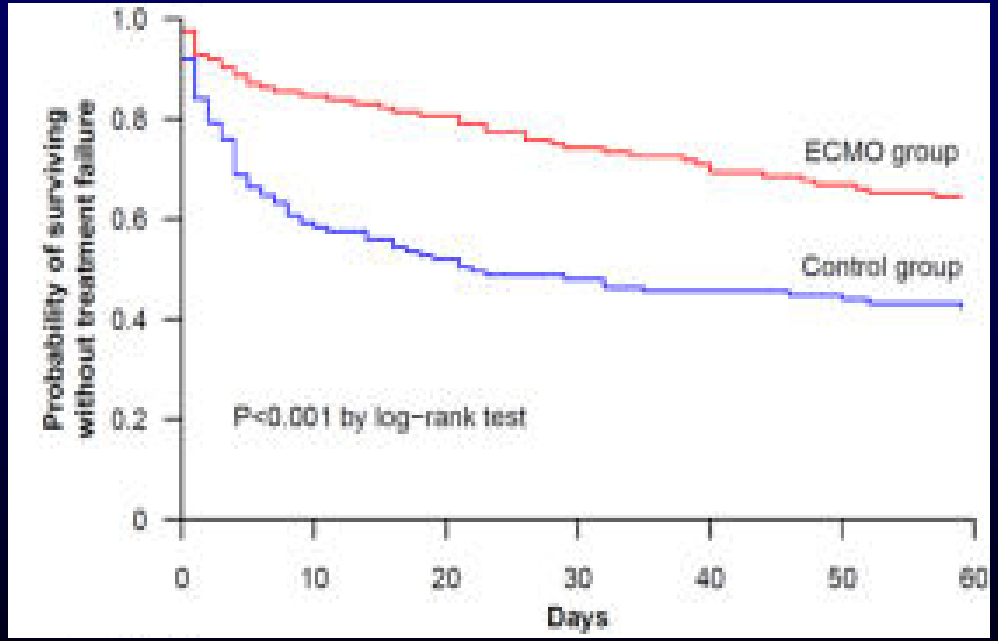
Hazard Ratio 0.70; 95%CI 0.47-1.04

2nd endpoint Treatment failure

Death in ECMO group patients; Death or Crossover to ECMO in control patients



RR 0.62; 95%CI 0.47-0.82



HR 0.48; 95%CI 0.34-0.70

Crossover to ECMO in Controls

- 28% (35/125) of controls received rescue ECMO
  - Refractory hypoxemia, 6.5±9.7 days postrandomization
- These patients had more severe ARDS at baseline
  - Higher Plateau pressure:
    - *31.7±5.5 vs 28.5±4.1 cm H_2O*
  - Higher Driving pressure:
    - *20.2±6.1 vs 16.6±5.3 cm H_2O*
  - Lower Respiratory system compliance:
    - *21.3±9.2 vs 27.1±11.0 ml/cm H_2O*
  - More quadrants with infiltrate on chest Xray:
    - *3.7±0.6 vs 3.3±0.9*

Learning from a Trial Stopped by a Data and Safety Monitoring Board

David Harrington, Ph.D., and Jeffrey M. Drazen, M.D.

to the control group. The second analysis used a rank-preserving structural-failure time model approach to attempt to recover the causal effect of ECMO. That approach yielded an estimated hazard ratio for death within 60 days of 0.51 (95% CI, 0.24 to 1.02). These three analyses all point to the same conclusion — ECMO probably has some benefit in this context, despite the trial not being traditionally positive. In addition, most of the other secondary outcomes favored ECMO.

CLINICAL DECISIONS

INTERACTIVE AT NEJM.ORG

Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Distress Syndrome

Opinion 1 (Michael A. Matthay)

This patient is an excellent candidate for ECMO if it can be delivered in a medical center that is experienced with this therapy.

CLINICAL DECISIONS

INTERACTIVE AT NEJM.ORG

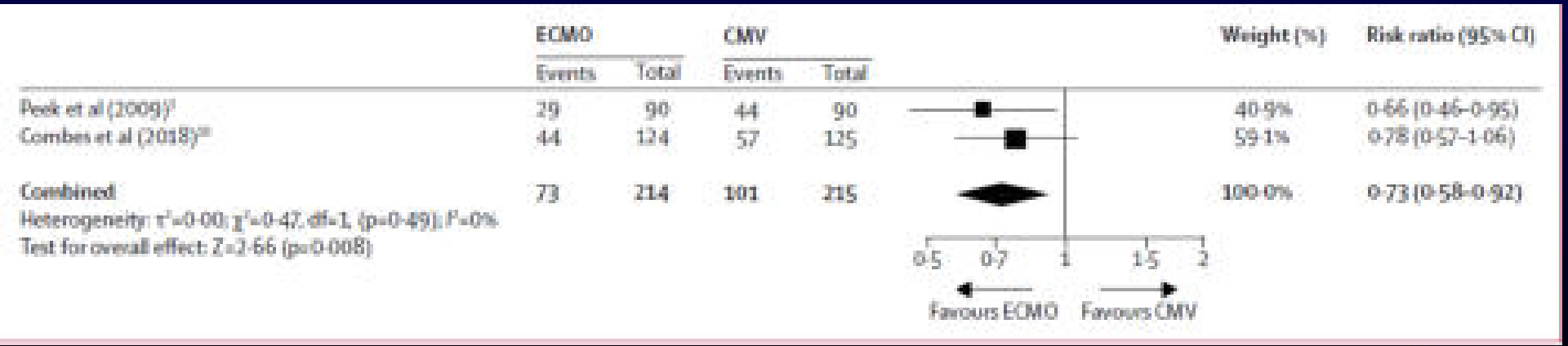
Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Distress Syndrome

Opinion 2 (Alan H. Morris)

The use of treatments, like ECMO, that have considerable dangers and that might harm more than help should be restricted to scientifically rigorous clinical investigations that are designed to produce maximally credible results. They should not be used widely in clinical care, and I would not introduce ECMO support for Mr. Jackson.

Venovenous extracorporeal membrane oxygenation for acute respiratory distress syndrome: a systematic review and meta-analysis

Laveena Munshi, Allan Walkey, Ewan Goligher, Tai Pham, Elizabeth M Uleryk, Eddy Fan



Editorials

1. **Michael Matthay**: I believe that the balance of evidence favours use of ECMO in severe ARDS if available from a medical centre experienced in provision of ECMO

1. **Alain Combes**: The question is no longer whether ECMO works, but “by how much does ECMO work, in whom, and at what cost?”

Frequentist analyse EOLIA

- mortaliteit ECMO is niet significant lager
  - RR 0.76; 95%CI 0.55-1.04, $p = 0.09$
  - conclusie: ECMO niet effectief
- dit is de benadering van ‘frequentisten’ om hypothese te testen
- het absolute verschil in mortaliteit van 11% is niet genoeg om de nul-hypothese te verwerpen

Thomas Bayes (1702-1761)

Bayesian Analyse

- Bayesiaanse kansen behoren tot de categorie van bewijsbare kansen
- De kans van een hypothese wordt geëvalueerd in het licht van nieuw verkregen kennis
- De a-priori kans wordt bijgesteld tot een a-posteriori kans in het licht van nieuwe, relevante gegevens

https://nl.wikipedia.org/wiki/Bayesiaanse_kans

Bayesian Analyse

- To estimate the posterior probabilities that the treatment effect exceeded a range of potential values for the minimum clinically important treatment effect
- Bijvoorbeeld:
  - RR: <1 <0.9 <0.8 etc.
  - ARR: 2% 4% 6% 8% 10% etc.

(Assuming a baseline mortality risk of 46% based on the EOLIA control group, ARR 2% would save 500 lives/year in the USA)

Bayesian Analyse EOLIA

Clinical Review & Education

JAMA | Special Communication | CARING FOR THE CRITICALLY ILL PATIENT

Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Distress Syndrome and Posterior Probability of Mortality Benefit in a Post Hoc Bayesian Analysis of a Randomized Clinical Trial

Ewan C. Goligher, MD, PhD; George Tomlinson, PhD; David Hajage, MD, PhD; Duminda N. Wijeysundera, MD, PhD; Eddy Fan, MD, PhD; Peter Jüni, MD; Daniel Brodie, MD; Arthur S. Slutsky, MD; Alain Combes, MD, PhD

A priori kansen

Table 1. Characteristics of Reference Prior Probability Distributions Representing Prior Beliefs About Mortality Benefit From ECMO in Patients With Very Severe ARDS

Prior Belief	Assumed Median RR	Assumed SD of Logarithm of RR	Prior Evidence Equivalent	Probability of Treatment Effect ≥Specified Threshold, %				Rationale for Specifying Distribution Characteristics
				RR <1	RR <0.9	RR <0.8	RR <0.67	
Minimally informative	1.0	1.0	Equivalent to essentially no prior belief	50	50	40	48	All possible values for treatment effect (i.e, log RR) are equally likely
Strongly enthusiastic	0.67	0.25	Equivalent to a previous RCT enrolling 100 patients finding 33% RR reduction	95	80	77	50	Probability of observing a treatment effect that assumed in ECLIA trial design (RR = 0.67) is 50%; probability of harm (RR >1) is 5%
Moderately enthusiastic	0.78	0.15	Equivalent to a previous RCT enrolling 264 patients finding 22% RR reduction	95	86	57	18	Probability of observing a treatment effect as that approximating effect observed in ARDSNet lower tidal volumes trial (RR = 0.78) is 50%; probability of harm (RR >1) is 5%
Skeptical	1.0	0.21	Equivalent to a previous RCT enrolling 100 patients finding 0% RR reduction	50	33	18	5	Probability of observing a treatment effect as that assumed in ECLIA trial design (RR = 0.67) is 5%; probability of benefit and harm are equivalent
Strongly skeptical	1.0	0.15	Equivalent to a previous RCT enrolling 264 patients finding 0% RR reduction	50	24	7	0	Probability of observing a treatment effect that observed in the ARDSNet lower tidal volumes trial (RR = 0.78) is 5%

Kansen na EOLIA

Table 2. Probability of Treatment Effects Estimated by Bayesian Analysis According to Varying Prior Beliefs About Mortality Benefit From ECMO in Patients With Very Severe ARDS

Prior Belief	Posterior Median RR (95% Credible Interval)	Posterior Probability That True RR Is <Specified Threshold, %			
		RR <1	RR <0.9	RR <0.8	RR <0.67
Reference prior distributions					
Minimally informative	0.78 (0.56-1.04)	96	85	60	18
Strongly enthusiastic	0.74 (0.57-0.95)	99	94	73	22
Moderately enthusiastic	0.78 (0.63-0.96)	99	91	61	8
Skeptical	0.84 (0.64-1.07)	93	73	39	5
Strongly skeptical	0.88 (0.71-1.09)	88	58	18	0

Bayesian Analyse EOLIA

- **Frequentist:**
  - **mortaliteit na 60 dagen met ECMO is niet significant lager dan in controle groep → ECMO is niet effectief**

- **Bayesian:**
  - **ECMO is waarschijnlijk effectief**
  - **doel is de kans bepalen op een gewenst/klinisch relevant effect i.p.v. het uitsluiten van een behandeleffect**
  - **Is meer intuïtief**

Bayesian Analyse EOLIA

- de kans dat ECMO sterfte enigszins reduceerd (RR<1) is hoog (88-99%)

- dus ECMO werkt bij ARDS:
  - hoe groot is effect?
    - EOLIA schatting was RR 0.67, resultaat RR 0.76
  - bij wie?
  - wat kost het?

eCPR

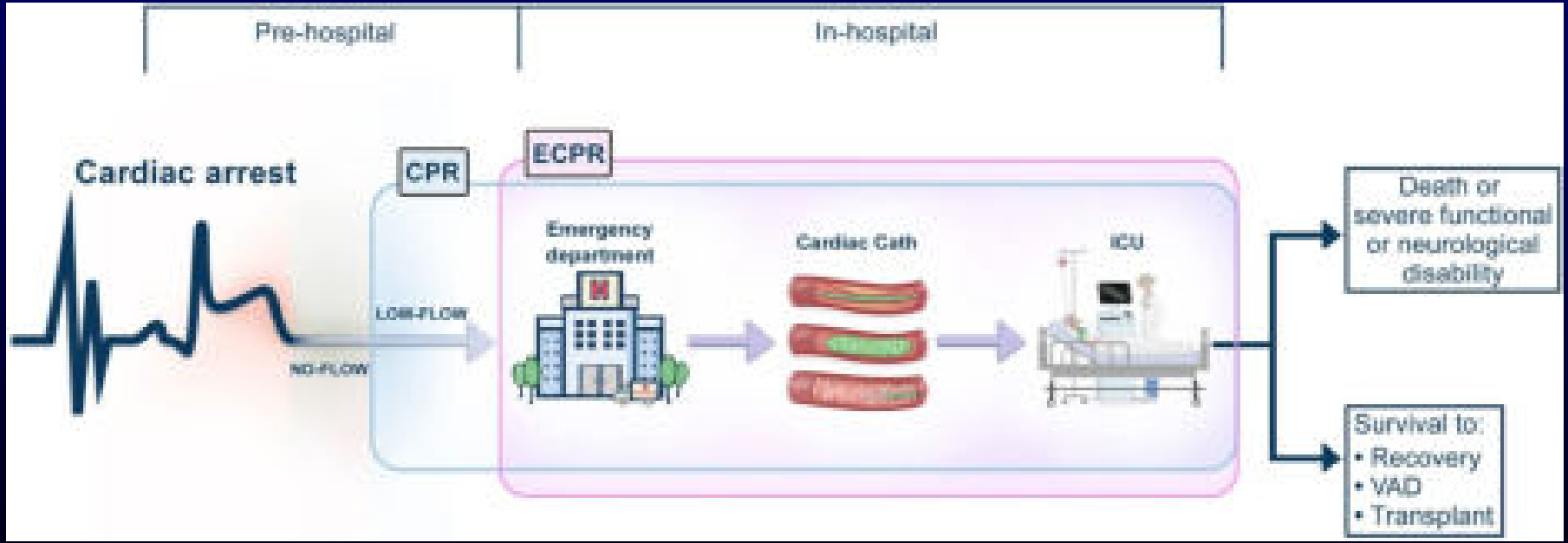

Pre-hospital
In-hospital
Cardiac arrest
CPR
ECPR
LOW-FLOW
NO-FLOW
Emergency department
Cardiac Cath
ICU
Death or severe functional or neurological disability
Survival to:
• Recovery
• VAD
• Transplant

Table 1 Notable published studies of ECPR

	Type of study	No. of subjects	Outcome measurement	Results^{a}
IHCA				
Chen [14]	Propensity-score matched analysis	46 matched pairs	Survival to discharge with CPC 1–2	ECPR vs CPR 30.4% vs 15.2%, HR 0.51 [0.35–0.74], $p < 0.0001^{b}$
Shin [15]	Propensity-score matched analysis	60 matched pairs	Two-year survival with minimal neurological impairment	ECPR vs CPR 20% vs 5%, HR = 0.53, [0.36–0.80], $p = 0.002$
Ouweneel [37]	Meta analysis of matched pairs analyses	195 matched pairs	30 day survival with CPC 1–2	ECPR vs CPR 23% vs 9.7%, RR 0.85,^{c} ARR 13%, [7–20%], $p = 0.0001$
IHCA and OHCA with in-hospital ECPR				
Lunz [40]	Multicenter retrospective study	IHCA: 163 OHCA: 238	3 month survival with CPC 1–2	IHCA vs OHCA 34.2% vs 9%, RR 0.72,^{c} $p < 0.01$
OHCA with in-hospital ECPR				
Choi [32]	Propensity-score matched analysis	320 matched pairs	Survival to discharge with CPC 1–2	ECPR vs CPR 9% vs 4%, OR, 2.58 95% CI, [0.81–2.16], p = NS
Yannopoulos [46]	ECPR protocol compared to historical controls	ECPR: 62 CPR: 170	Survival to discharge with CPC 1–2	ECPR vs CPR 43.9% vs 15.3%, OR 4,^{d} [2.08–7.7], $p < 0.0001$
Yannopoulos [47]	RCT of ECPR or standard ACLS	ECPR: 15 ACLS: 15	Survival to hospital discharge	ECPR vs ACLS 43% [21.3–67.7] vs 7% [1.6–30.2], risk difference 36% [3.7–59.2], RR 0.61,^{c} posterior probability of ECPR superiority: 0.9861
Bel [48]	RCT of ECPR or standard ACLS	ECPR: 124 ACLS: 132	6-month survival with CPC 1 or 2	ECPR vs ACLS 31.5% vs 22%, RR 0.88,^{c} $p = 0.09$
Hsu [33]	Pilot trial of expedited transport and ECPR initiation or standard care	Expedited transport: 12 (ECPR 5 of 12) Standard: 3	ED arrival interval; ECPR initiation interval	911 to ED arrival < 30 min: 40% ED arrival to ECPR < 30 min: 60%
OHCA with pre-hospital or in-hospital ECPR				
Lamhaut [60]	Observational study comparing ECPR protocols	Period 1: 114 Period 2: 42	Survival with CPC 1 or 2 at ICU discharge or day 28	Period 2 vs Period 1^{e} 28.6% vs 7.9%, RR 0.78,^{c} $p < 0.001$
Bougouin [23]	Population based registry study	ECPR: 525 CPR: 12,666	Survival to hospital discharge	ECPR vs CPR 8.4% vs 8.6%, $p = 0.91$; OR 1.3, [0.8–2.1], $p = 0.28^{f}$ Pre-hospital ECPR vs In-hospital ECPR OR 2.9^{d} 95% CI 1.5–5.8 $p = 0.002$

Abrams.
ICM 2022

Table 1 Notable published studies of ECPR

	Type of study	No. of subjects	Outcome measurement	Results
IHCA				
Chen [14]	Propensity-score matched analysis	46 matched pairs	Survival to discharge with CPC 1–2	ECPR vs CPR 10.8% vs 15.2%, HR 0.51, [0.35–0.74], p < 0.0001
Shin [15]	Propensity-score matched analysis	60 matched pairs	Two-year survival with minimal neurological impairment	ECPR vs CPR 20% vs 5%, HR = 0.53, [0.36–0.80], p = 0.002
Ouweneel [37]	Meta-analysis of matched pairs analyses	135 matched pairs	30-day survival with CPC 1–2	ECPR vs CPR 23% vs 9.7%, RR 0.85, ARR 13%, [7–20%], p = 0.0001
IHCA and OHCA with in-hospital ECPR				
Lunz [40]	Multicenter retrospective study	IHCA 163 OHCA 238	3-month survival with CPC 1–2	IHCA vs OHCA 14.2% vs 9%, RR 0.72, p = 0.01
OHCA with in-hospital ECPR				
Choi [32]	Propensity-score matched analysis	320 matched pairs	Survival to discharge with CPC 1–2	ECPR vs CPR 9% vs 6%, OR 1.58 95% CI 0.81–2.14, p = NS
Yannopoulos [46]	ECPR protocol compared to historical controls	ECPR 62 CPR 170	Survival to discharge with CPC 1–2	ECPR vs CPR 41.9% vs 15.3%, OR 4.1 [2.08–7.7], p < 0.0001
Yannopoulos [47]	RCT of ECPR or standard ACLS	ECPR 15 ACLS 15	Survival to hospital discharge	ECPR vs ACLS 43% [21.3–67.7] vs 7% [1.6–30.2], risk difference 36% [7.7–59.2], RR 0.61, posterior probability of ECPR superiority 0.9861
Belohlavek [48]	RCT of ECPR or standard ACLS	ECPR 124 ACLS 132	6-month survival with CPC 1 or 2	ECPR vs ACLS 31.5% vs 22%, RR 0.86, p = 0.09
Hsu [23]	Pilot trial of expedited transport and ECPR initiation or standard care	Expedited transport 12 (ECPR 5 of 12) Standard 3	ED arrival interval, ECPR initiation interval	911 to ED arrival < 30 min: 42% ED arrival to ECPR < 30 min: 60%
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Bougouin [23]	Population-based registry study	ECPR 525 CPR 12,666	Survival to hospital discharge	ECPR vs CPR 8.4% vs 8.6%, p = 0.91; OR 1.3, [0.8–2.1], p = 0.24 Pre-hospital ECPR vs in-hospital ECPR OR 2.9 95% CI 1.5–5.8, p = 0.002

Abrams. ICM 2022

Advanced reperfusion strategies for patients with out-of-hospital cardiac arrest and refractory ventricular fibrillation (ARREST): a phase 2, single centre, open-label, randomised controlled trial

Demetris Yannopoulos, Jason Bartos, Ganesh Raveendran, Emily Walser, John Connett, Thomas A Murray, Gary Collins, Lin Zhang, Rajat Kalra, Marinos Kosmopoulos, Ranjit John, Andrew Shaffer, RJ Frascone, Keith Wesley, Marc Conterato, Michelle Biros, Jakub Tolar, Tom P Aufderheide

Summary

Background Among patients with out-of-hospital cardiac arrest (OHCA) and ventricular fibrillation, more than half present with refractory ventricular fibrillation unresponsive to initial standard advanced cardiac life support (ACLS) treatment. We did the first randomised clinical trial in the USA of extracorporeal membrane oxygenation (ECMO)-facilitated resuscitation versus standard ACLS treatment in patients with OHCA and refractory ventricular fibrillation.

Lancet 2020; 396: 1807–16
Published Online November 13, 2020
https://doi.org/10.1016/S0140-6736(20)32338-2

- **Hybride design met Bayesian group sequential monitoring and response adaptive randomization after each group of 30 participants**

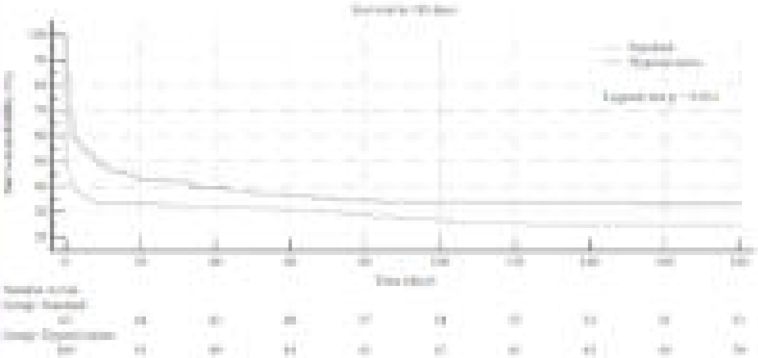
ARREST trial

- N=30 1e interim analyse
- 6 mnd overleving significant beter in ECMO group
- 43% vs. 7%
  - Risk difference 36% [4-59%]
- posterior probability of ECMO superiority 0.9861

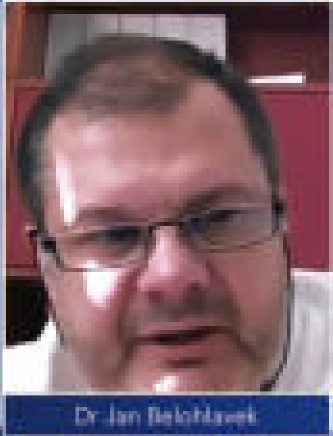
- trial gestaakt op last DSMC

Outcomes

	Standard (N = 132)	Hyperinvasive (N = 124)	P value
Primary outcome			
Survival with CPC at 180 days			
1 or 2	29 (22.0 %)	39 (31.5 %)	0.09
≥3	103 (78.0 %)	85 (68.5 %)	
Secondary outcomes			
Neuro recovery at 30 days			
Yes	24 (18.2 %)	38 (30.6 %)	**0.02**
No	108 (81.8 %)	86 (69.4 %)	
Cardiac recovery at 30 days			
Yes	45 (34.1 %)	54 (43.5 %)	0.12
No	87 (65.9 %)	70 (56.5 %)	



Bayesian analysis of the primary outcome



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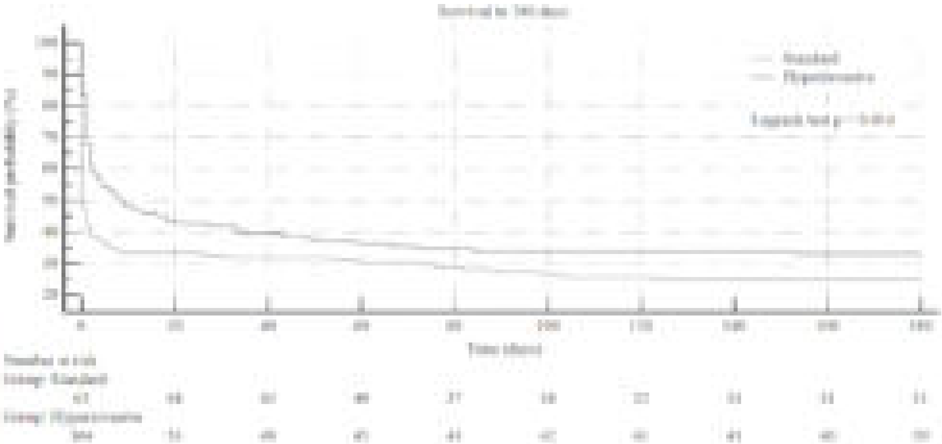
Cardiac recovery at 30 days			
Yes	45 (34.1 %)	54 (43.5 %)	0.12
No	87 (65.9 %)	70 (56.5 %)	



Bayesian analysis of the primary outcome

Panel A. [illegible]

Scenario	Prior OR	Prior std. dev. of log(OR)	Odds ratio: Posterior median	Odds ratio: 95% CI	Effect difference: Posterior median	Effect difference: 95% CI
Weakly informative	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mild enthusiastic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Moderately enthusiastic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Strongly enthusiastic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mild sceptical	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Moderately sceptical	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Strongly sceptical	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Panel B. [illegible]

Scenario	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Weakly informative	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mild enthusiastic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Moderately enthusiastic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Strongly enthusiastic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mild sceptical	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Moderately sceptical	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Strongly sceptical	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Ongoing trials → INCEPTION!

Table 3 Ongoing controlled trials of ECPR for out-of-hospital cardiac arrest

Title	Study design	Sample size	Brief description	Primary outcome(s)
Early initiation of extracorporeal life support in refractory OHCA (INCEPTION); NCT03101787	Multi-center randomized controlled trial	110	ECPR versus conventional CPR	30-day survival with favorable neurological status (CPC 1 or 2)
EC ECPR trial for out-of-hospital cardiac arrest; NCT02932752	Non-randomized, controlled parallel group trial (allocation based on region of treatment)	420	Incorporation of ECPR into regional medical system, compared to regions providing usual care	CPC status at hospital discharge
CPR, pre-hospital ECMO and early reperfusion (CHEER 3 Trial) for patients in refractory cardiac arrest to improve survival to hospital discharge	Single-center feasibility study	25	Implementation of pre-hospital ECPR	CPC status at hospital discharge
Pre-hospital ECMO in advanced resuscitation on patients with refractory cardiac arrest (SURB0); NCT03700125	Single-center feasibility study	6	Implementation of a pre-hospital ECMO-capable cardiac arrest team	Proportion of patients successfully established with pre-hospital ECPR within 20 min of collapse

CPR cardiopulmonary resuscitation, ECPR extracorporeal cardiopulmonary resuscitation, ECMO extracorporeal membrane oxygenation, CPC cerebral performance status, OHCA out-of-hospital cardiac arrest

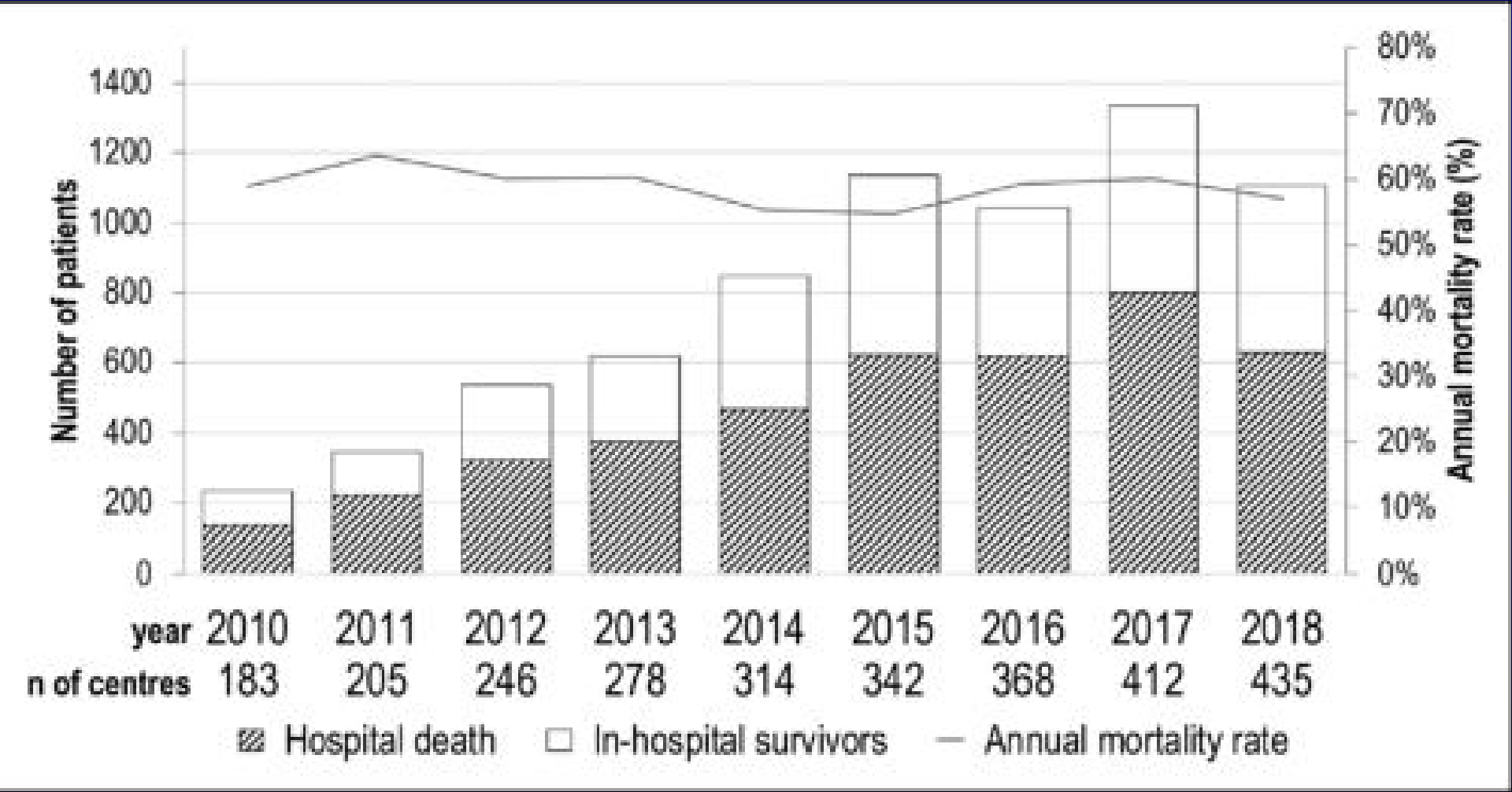
Post-cardiotomie

Venoarterial Extracorporeal Membrane Oxygenation for Postcardiotomy Shock—Analysis of the Extracorporeal Life Support Organization Registry*

Mariusz Kowalewski,

OBJECTIVES: Refractory postcardiotomy cardiogenic shock complicat-

Kowalewski. CCM 2021


Number of patients
1400
1200
1000
800
600
400
200
0
80%
70%
60%
50%
40%
30%
20%
10%
0%
Annual mortality rate (%)
year 2010 2011 2012 2013 2014 2015 2016 2017 2018
n of centres 183 205 246 278 314 342 368 412 435
Hospital death
In-hospital survivors
Annual mortality rate

Post-cardiotomie

- steeds vaker
- mortaliteit 50-60%
- geen RCTs

- Effect ECMO onduidelijk
  - Sterfte bij niet doen 100%?

Kosten

PharmacoEconomics - Open (2021) 5:613–623
https://doi.org/10.1007/s41669-021-00272-9

SYSTEMATIC REVIEW

Hospital Costs of Extracorporeal Membrane Oxygenation in Adults: A Systematic Review

Annemieke Oude Lansink-Hartgring[1] · Olivier van Minnen[1] · Karin M. Vermeulen[2] · Walter M. van den Bergh[1] on behalf of the Dutch Extracorporeal Life Support Study Group

Oude Lansink-Hartgring. PharmacoEconomics 2021

In-hospital costs ECMO

Systematic review

- enorme verschillen:
  - eRCP 22.000-318.000
  - post-cardiotomie 43.000-144.000
  - cardiogene shock 55.000-187.000
  - LTX 323.000-335.000
  - ARDS 54.000-193.000
- declaratie vs. cohort, USA vs. elders

Table 4 Hospital costs according to diagnosis

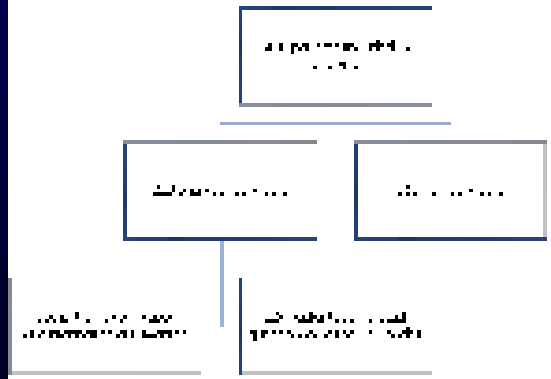
First author	Diagnosis	Costs in 2019 US$
Kawashima [31]	ECPR	22,305–38,553
Tseng [24]	ECPR	33,140
Dennis [30]	ECPR	51,821
Borisenko [32]	ECPR	67,682
Oude Lansink-Hartgring [23]	ECPR	69,578
Bharmal [9]	ECPR	318,187
Tseng [24]	Post-cardiotomy	43,245
Oude Lansink-Hartgring [23]	Post-cardiotomy	91,732
Maxwell [25]	Post-cardiotomy	125,466
Jäämaa-Holmberg [33]	Post-cardiotomy	143,729
Chang [26]	Cardiogenic shock	55,197
Maxwell [25]	Cardiogenic shock	181,776
Jäämaa-Holmberg [33]	Cardiogenic shock and cardiac arrest	187,202
Maxwell [25]	Lung transplant	322,568
Hayanga [21]	Lung transplant	334,008
Tseng [24]	Respiratory	54,336
Oude Lansink-Hartgring [23]	Respiratory	120,920
Peek [4]	Respiratory	181,532
Maxwell [25]	Respiratory	193,198

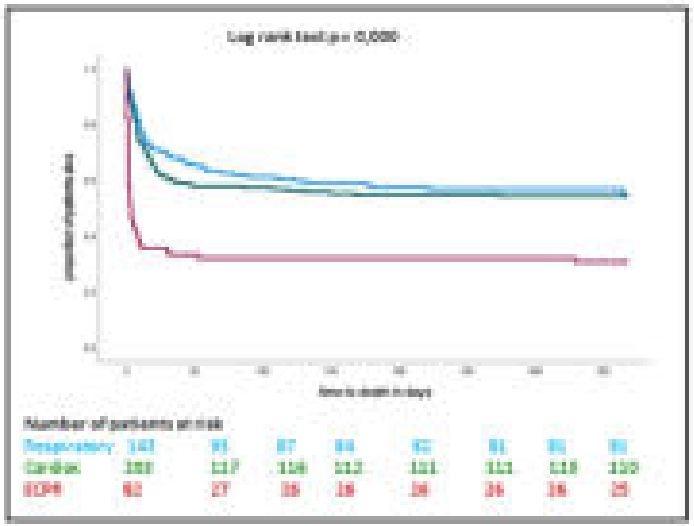
CEES studie

- Prospective observational cohort study op 10 IC's in Nederland van augustus 2017 tot juli 2019
- 428 patients met ECMO op IC
  - 143 (33%) respiratory support
  - 203 (48%) cardiac support
  - 82 (19%) eCPR

http://dutcheclsstudygroup.nl

CEES studie





CEES studie
voorspelling mortaliteit

- APACHE IV score (opname IC)
- SOFA score (dag ECMO)
  - zeer slechte voorspeller mortaliteit
  - sterke onderschatting van werkelijke sterfte
- → patient kan niet eigen controle zijn

CEES study

societal one-year costs in $2019

	All patients *N=129*	Resp. support N=51	Cardiac support N= 62	ECPR N=16
Hospital costs	*143.443 (70%)*	190.276 (75%)	93.165 (61%)	70.188 (53%)
Follow up costs	*53.752*	53.140	54.447	52.958
Costs of absenteeism	*7.317*	9.772	4.885	8.935
Total costs	*204.513*	253.189	152.498	132.082

CEES study

kosten / QALY = kosteneffectiviteit

	Resp. support	Cardiac support	ECPR
Total costs	253,189	152,498	132,082
Overall health (Utility)	0,80	0,78	0,64
mortality CEES [ECMO]	46%	46%	70%

CEES study

kosten / QALY = kosteneffectiviteit

	Resp. support	Cardiac support	ECPR
Total costs	253,189	152,498	132,082
Overall health (Utility)	0,80	0,78	0,64
mortality CEES [ECMO]	46%	46%	70%
mortality EOLIA/Prague [controls]	46%	?	69%

Kosteneffectiviteit
VV-ECMO

Effect & QALY:			
	QoL	0.8	
	Levensverwachting	20jr	
	Effect VV-ECMO	10%	
	QALY		1.6
Kosten:			
	1e jaar	$250.000	
	levenslang	$350.000	
	t.o.v. non-ECMO	+$175.000	
	Kosten/QALY		$109.000
			€100.000

Conclusie

- societal costs 1e jaar hoog
- lange overleving met goede QoL mogelijk
- ECMO mogelijk al kosteneffectief bij klein effect
  - effectiviteit ECMO is echter niet geheel duidelijk
- willingness to pay €100.000 ?