ECMO

Extrakorporeal membranoxygenering

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SVENSKA INTENSIVVÅRDSREGISTRET
SIR

Karolinska Institutet
KAROLINSKA Universitetssjukhuset

ecmo

Forsknings- och Registeransvarig
ECMO Centrum Karolinska

ELSO Registry Committee
Extracorporeal Life Support Organization (ELSO), Ann Arbor, MI, USA

Scientific Committee
Workgroup on Innovation for ECMO and ECLS
EuroELSO, Newcastle upon Tyne, UK

Stöd för avdelningar som bedriver *Extracorporeal life support* (ECLS):

- Utbildning
- Guidelines
- Forskning och forskningsstöd
- Publikationer
- Patientdataregister (ELSO Registry)
- Samhälle

Genomlyser verksamheter och kan utse *Centers of Excellence in Extracorporeal Life Support*

Esperanza, age 1 day, 1975. (Courtesy of Robert Bartlett, MD)

ECMO Centre Karolinska, Stockholm

Respiratory ECMO centre *est.* 1987 (ELSO center #36)
Pure ECMO ICU – 1.300 runs.
All age groups (45% adults)
All causes except post-cardiotomy
80-90 annual runs in ECMO ICU
60% commenced on VA ECMO; septic shock, etc.
No perfusionists – ECMO specialist nurses and physicians

Transport organization *est.* 1995, first transport 1996
85-95 annual National and International transports
60% by aircraft
88% primary transports

ecmo

The ECMO trial

Neonatal patients, intention to treat

185 patients

Cost effective and increased survival for ECMO

- 93 ECMO 63 survived (68%) [78 got ECMO, surv 81%]
- 92 conv. 38 survived (41%)

Lancet 1996;348(9020):75-82

CESAR study

Adult ECMO-trail intention to treat

Planned for 325 patients.

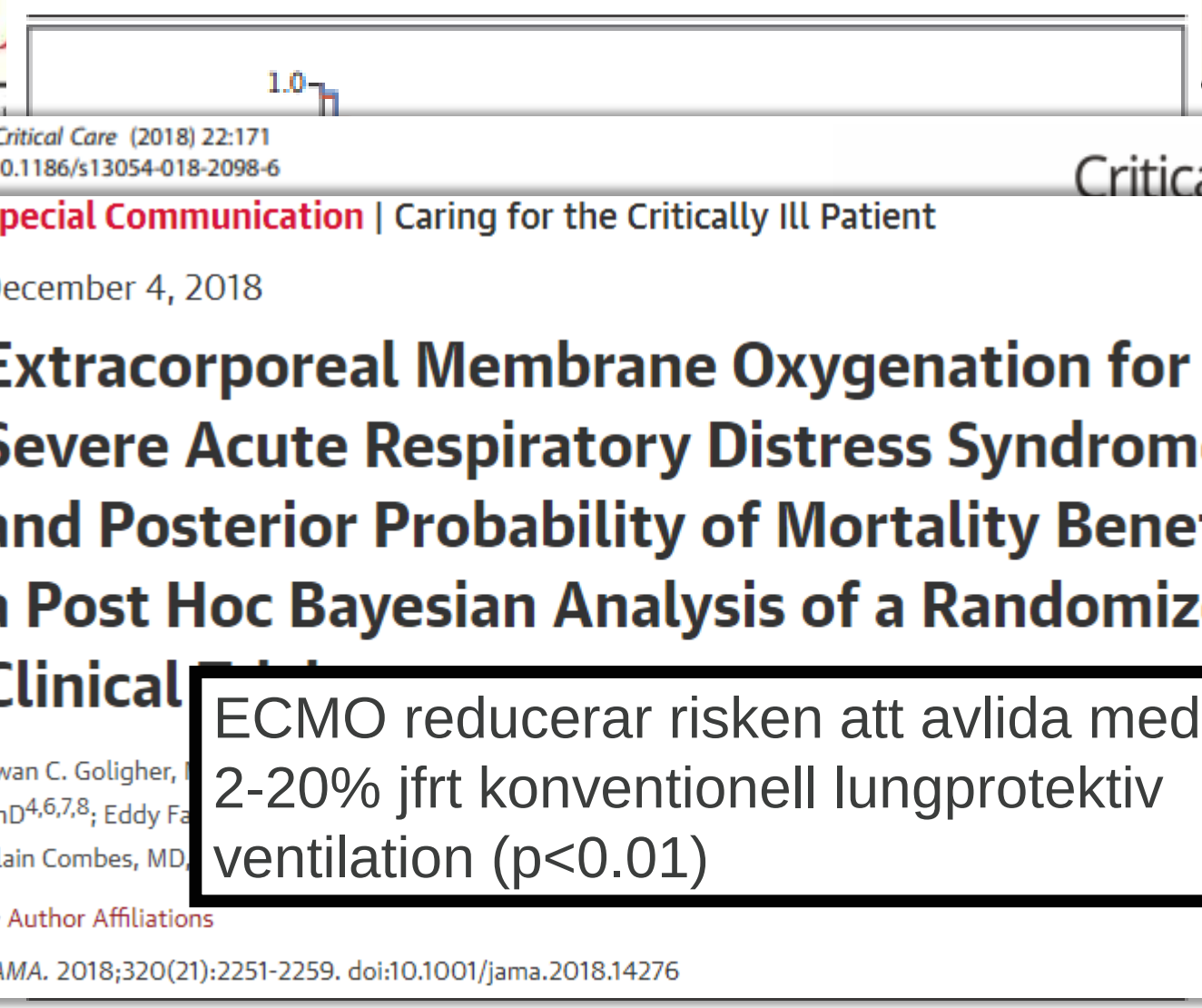
Interupted after 180 pat because of significance (p=0,03)

Death or severe disability at 6 months

90 in ECMO	57 survived (63%)
90 in Conventional arm	41 survived (46%)

Peek G. et al. Lancet 2009;374

The NEW ENGLAND JOURNAL of MEDICINE



Gattinoni *et al. Critical Care* (2018) 22:171
https://doi.org/10.1186/s13054-018-2098-6

Critical Care

EDITO

Use
reall

Luciano G

Special Communication | Caring for the Critically Ill Patient

December 4, 2018

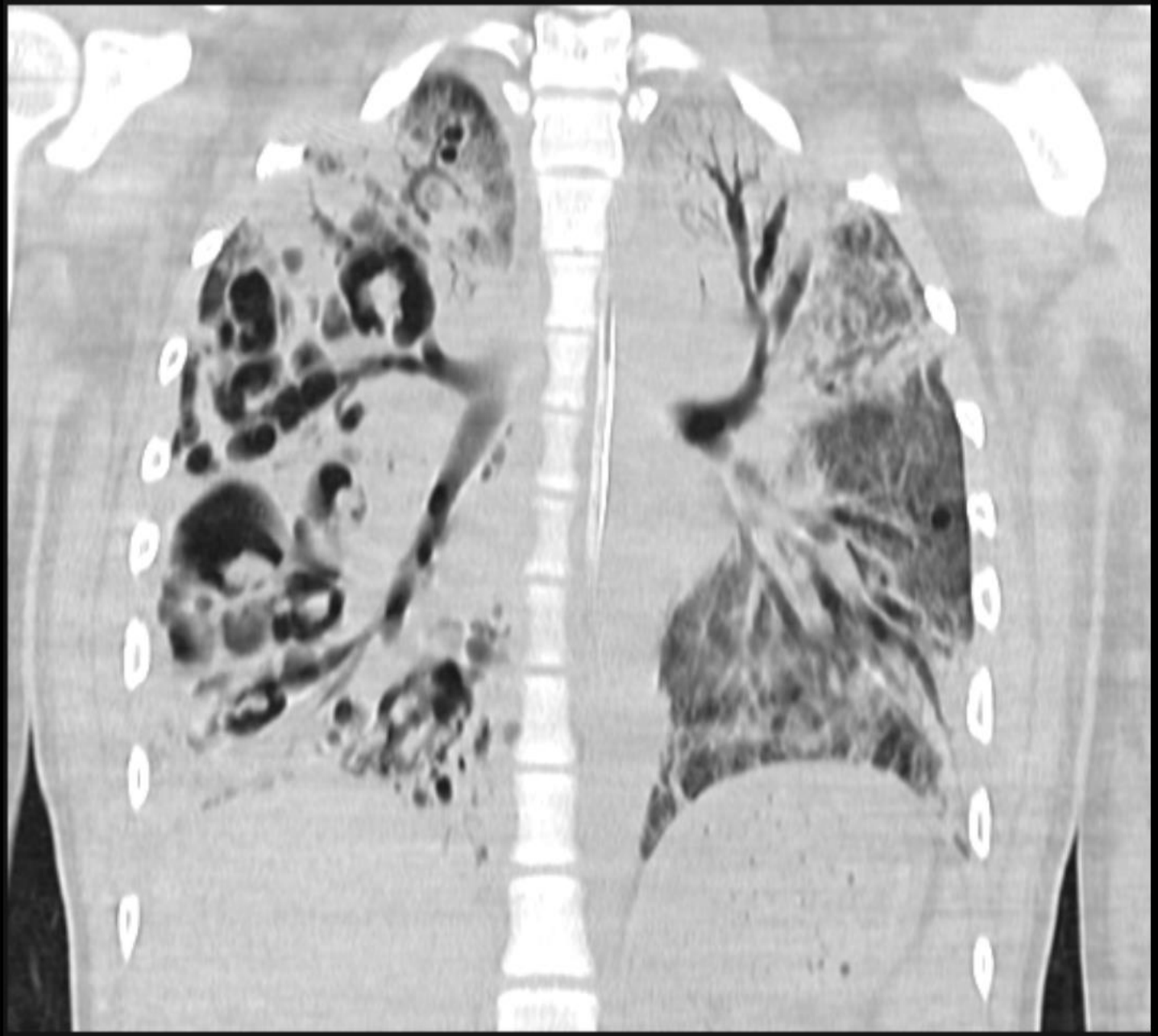
Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Distress Syndrome and Posterior Probability of Mortality Benefit in a Post Hoc Bayesian Analysis of a Randomized Clinical

ECMO reducerar risken att avlida med 2-20% jfrt konventionell lungprotektiv ventilation (p<0.01)

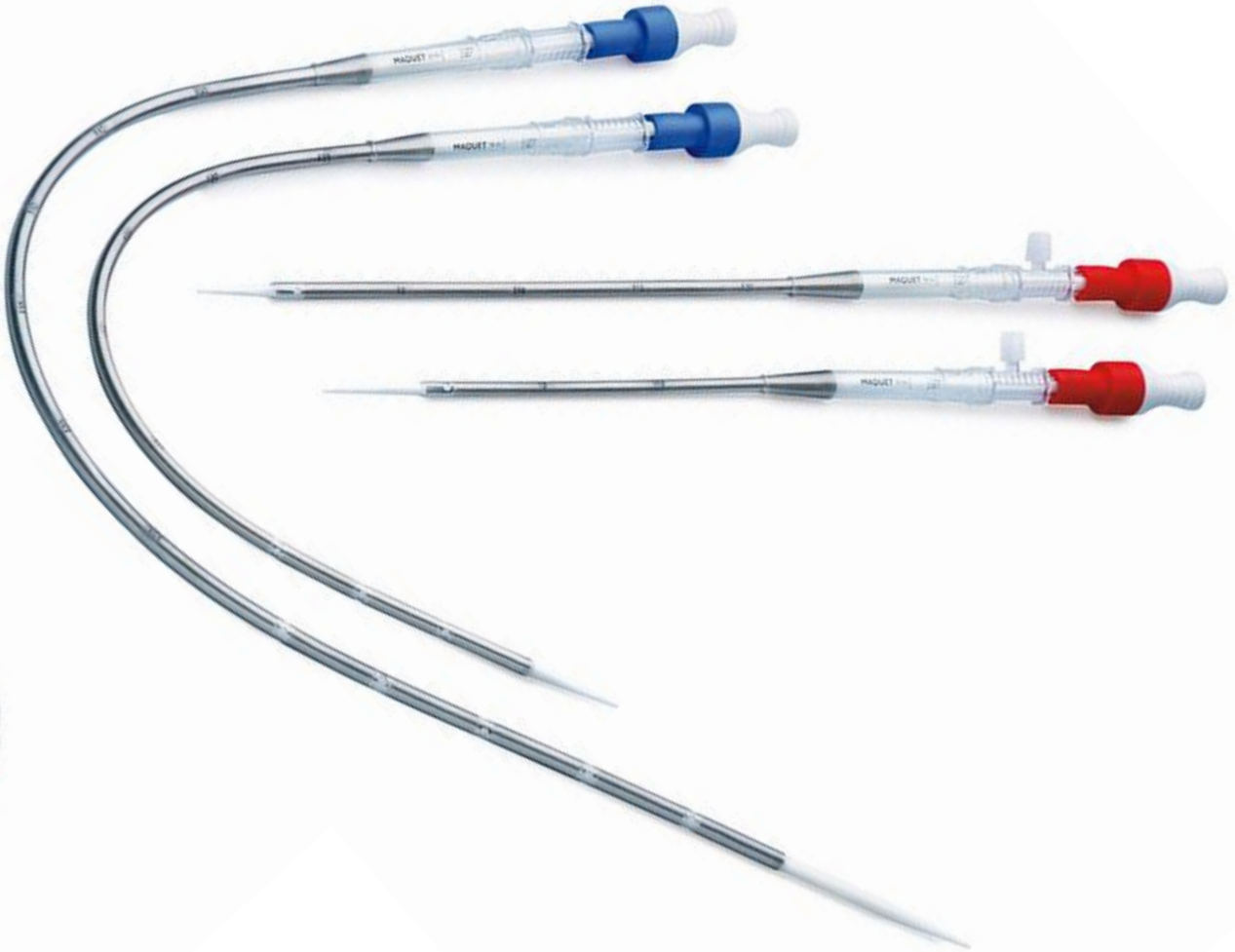
Ewan C. Goligher, MD, PhD[4,6,7,8]; Eddy Fa
Alain Combes, MD,

» Author Affiliations

JAMA. 2018;320(21):2251-2259. doi:10.1001/jama.2018.14276




27Fr



Maquet Quadrox-iD

Medos Hilite 2400 LT

Medos Hilite

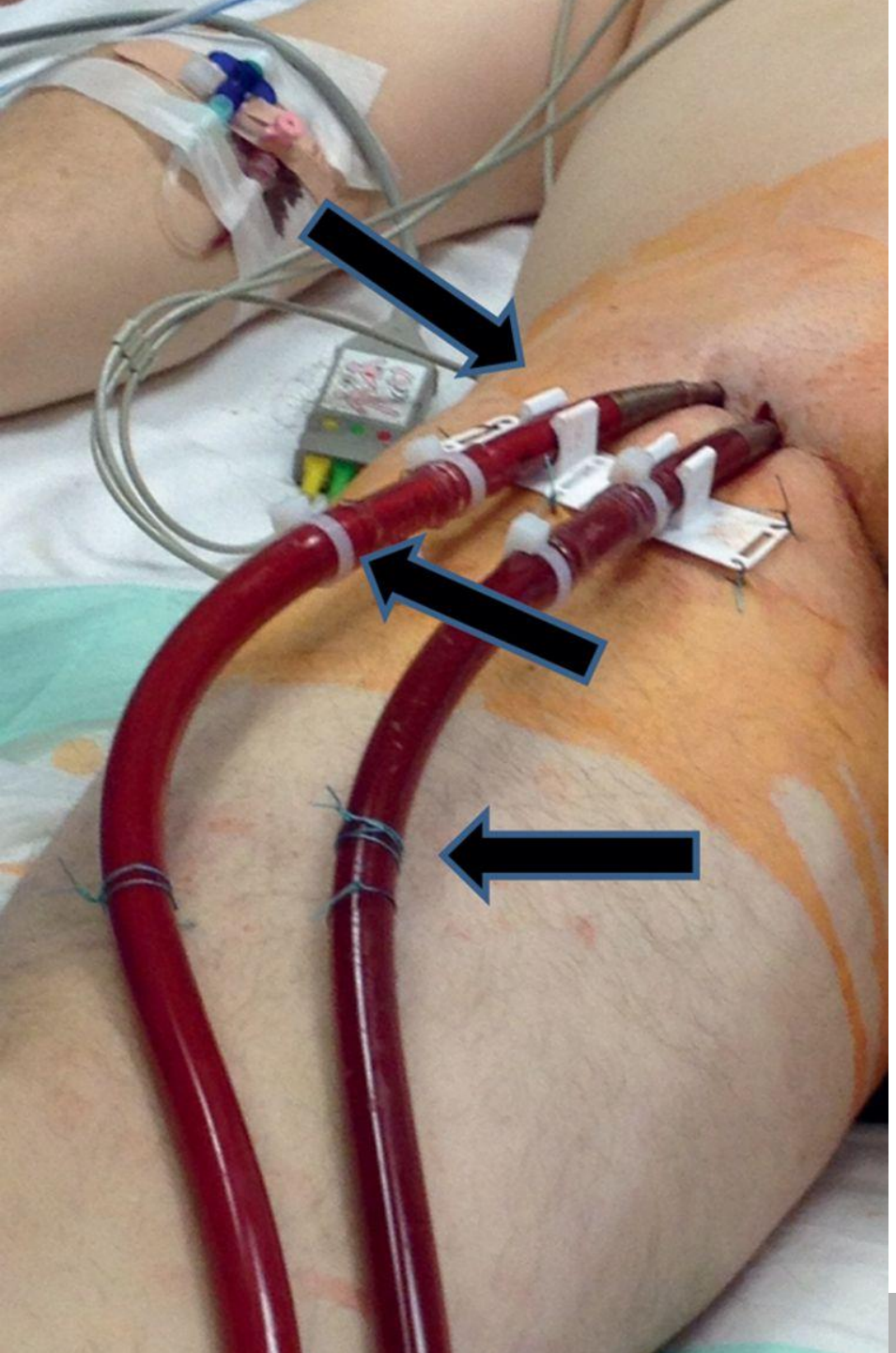
New Born

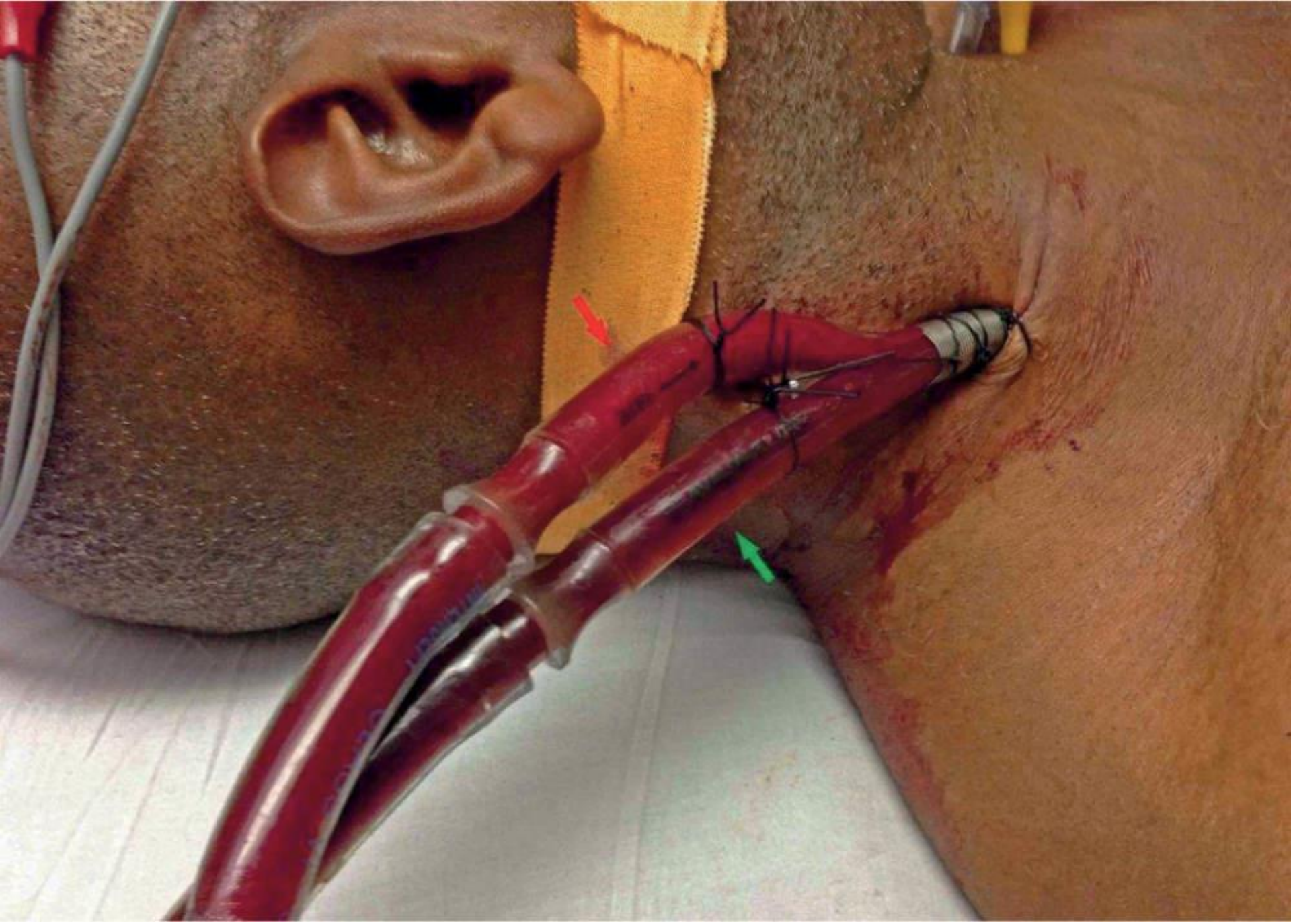
Sorin Lilliput 2

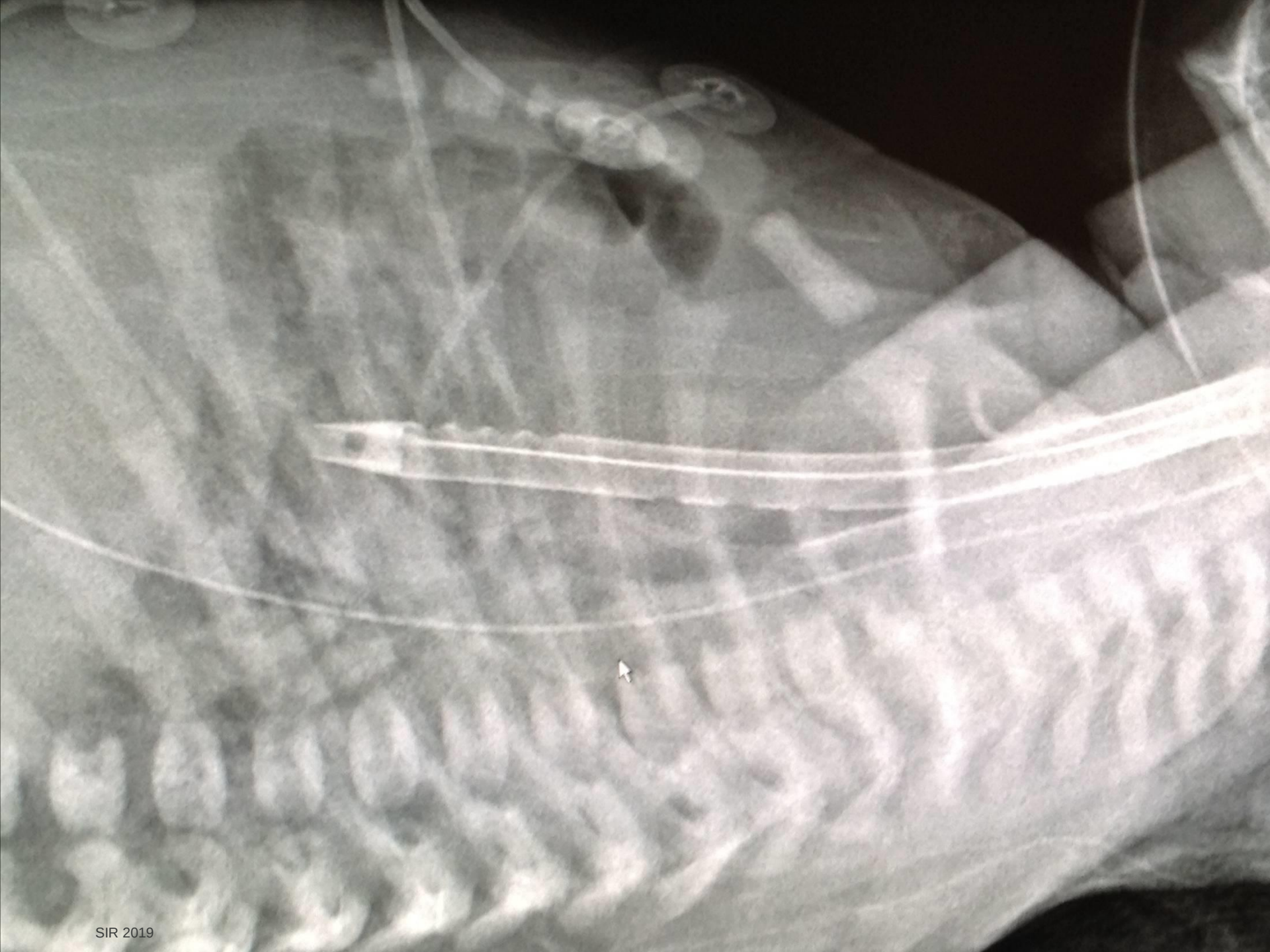
Sorin EOS ECMO

Chalice Paragon^{PMP} Pediatric, Infant and Neonatal

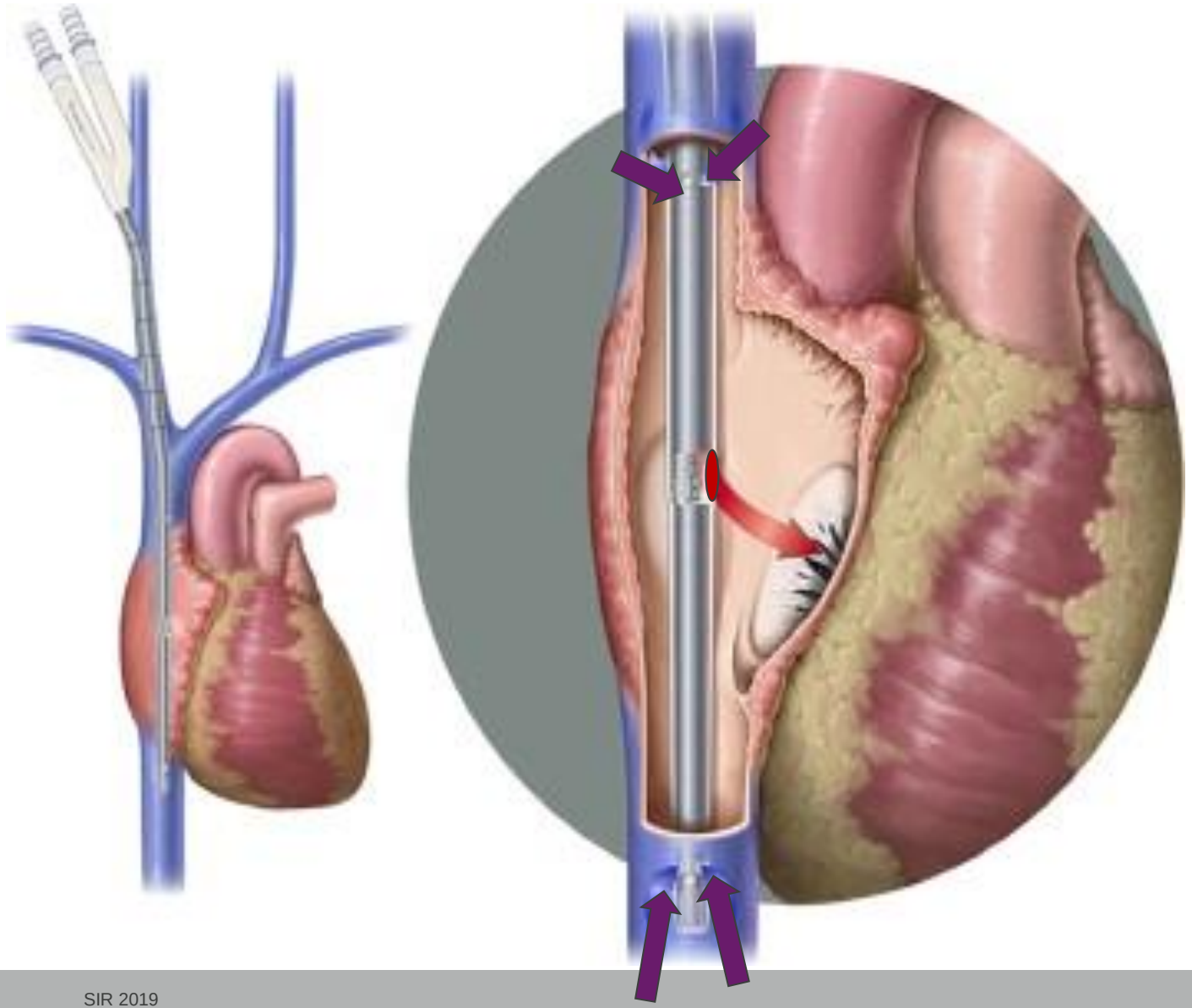
J Donald Hill MD and Maury Bramson BME, Santa Barbara, Ca, 1971. (Courtesy of Robert Bartlett, MD)





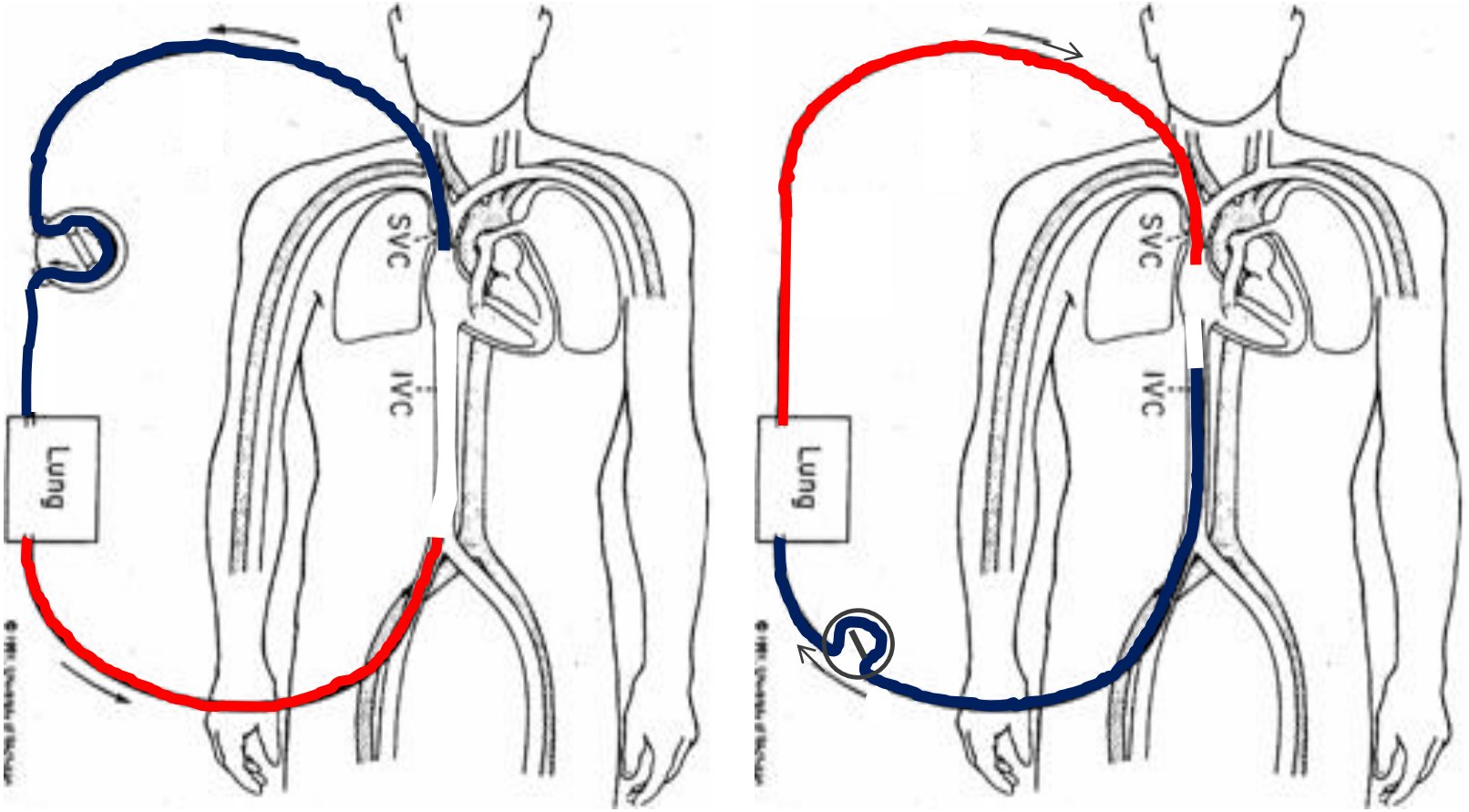


V-V ECMO
Dual Lumen Cannula (DLC)



V-V ECMO

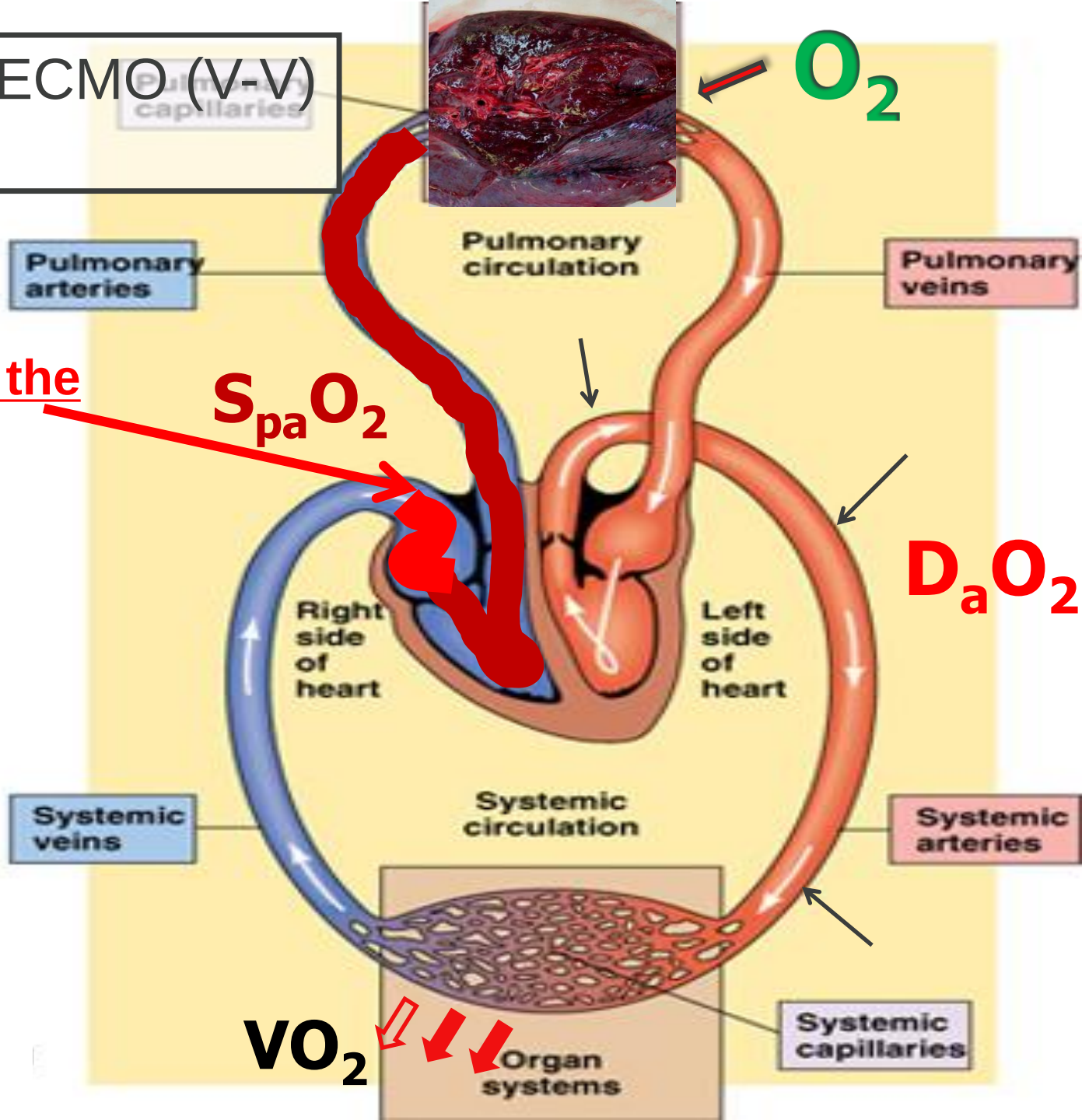
Single Lumen Cannulae (SLC)



Atrio-Femoral

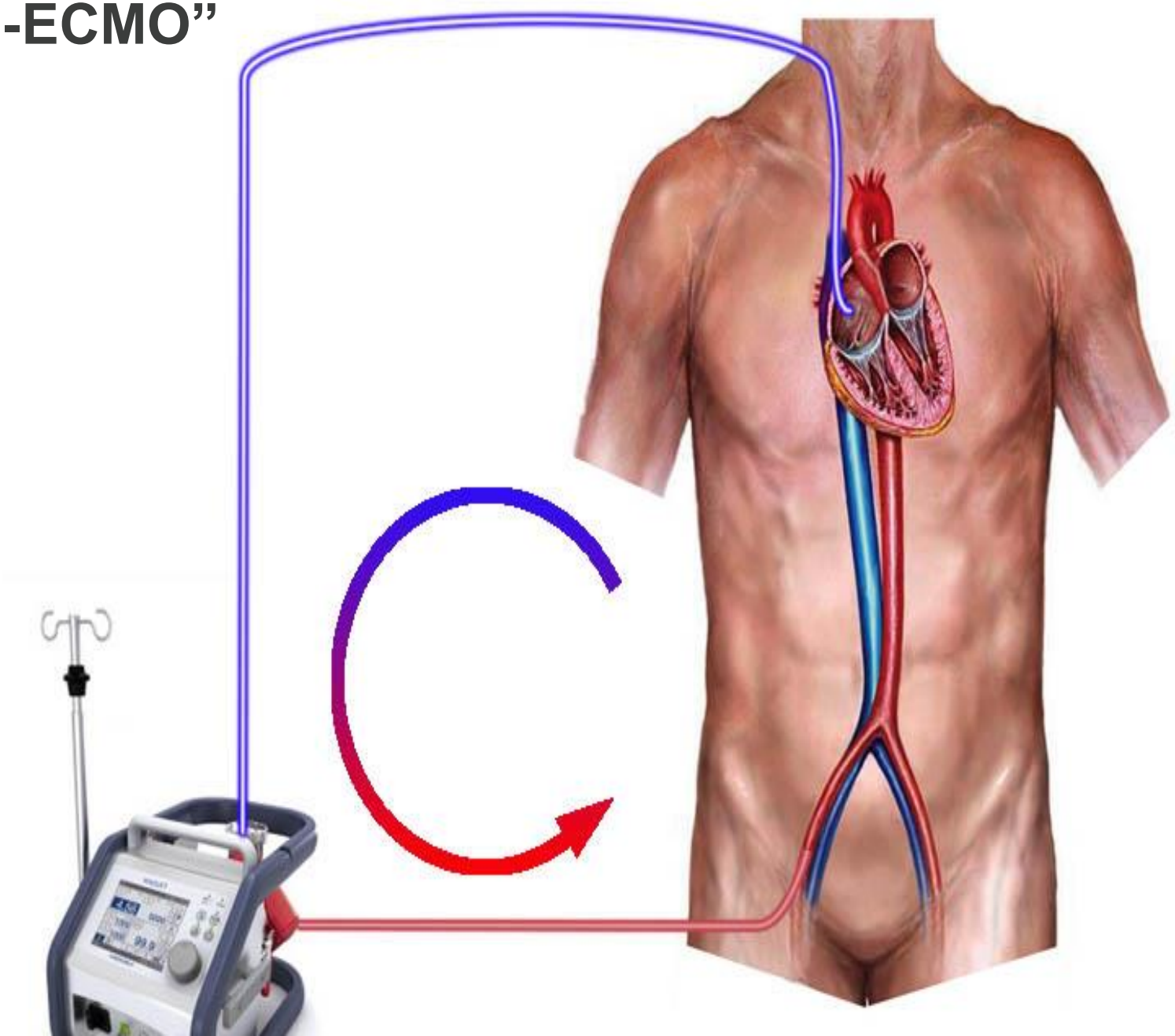
Femoro-Atrial

Veno-venous ECMO (V-V)
”Lung ECMO”



Veno-artäriell (VA) ECMO

”Hjärt/lung-ECMO”



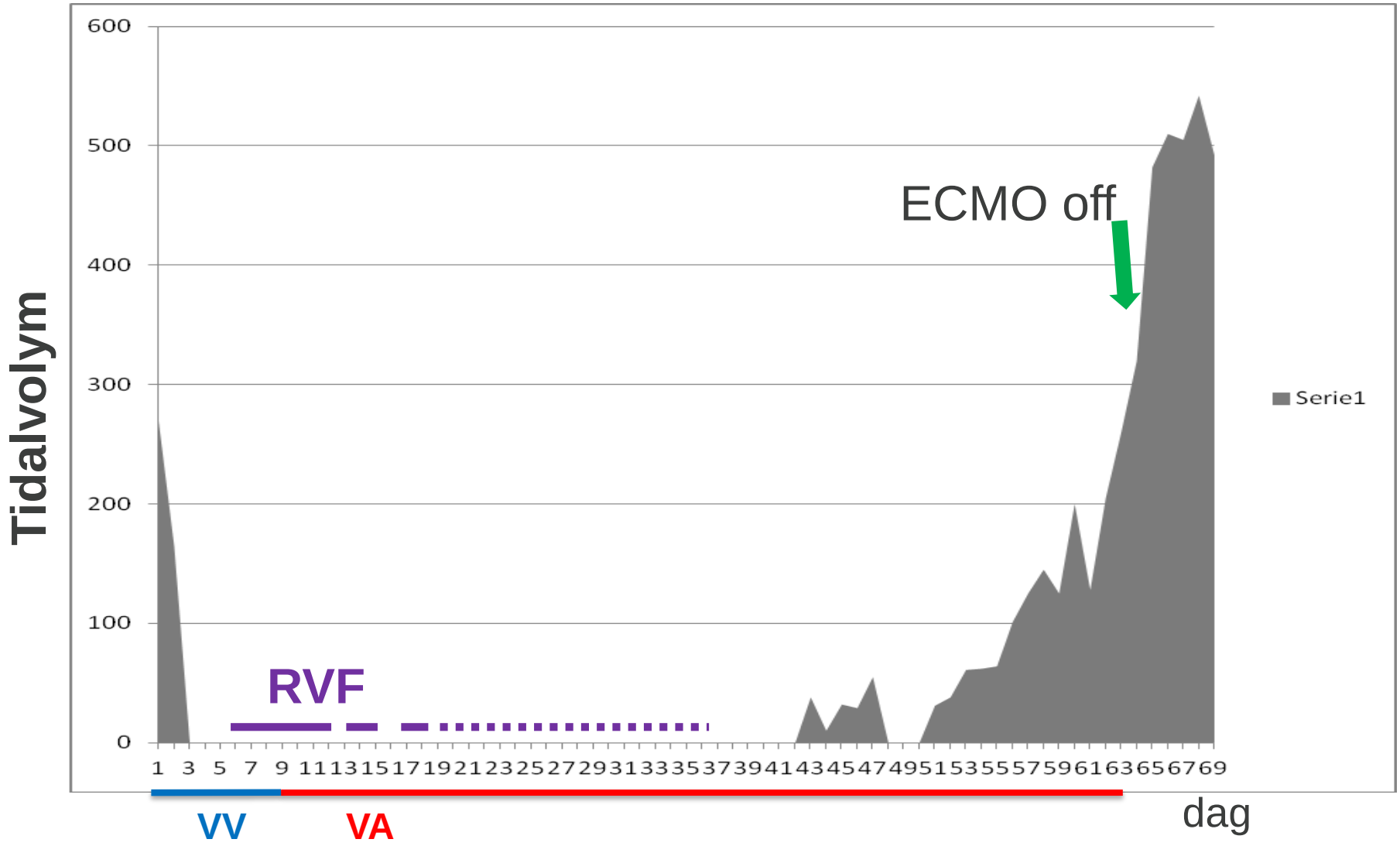
Heparin
DTI: bivalirudin, argatroban


KAROLINSKA
University Hospital


SIR 2019

Tidal volume during ARDS

Median 9-15 dygn



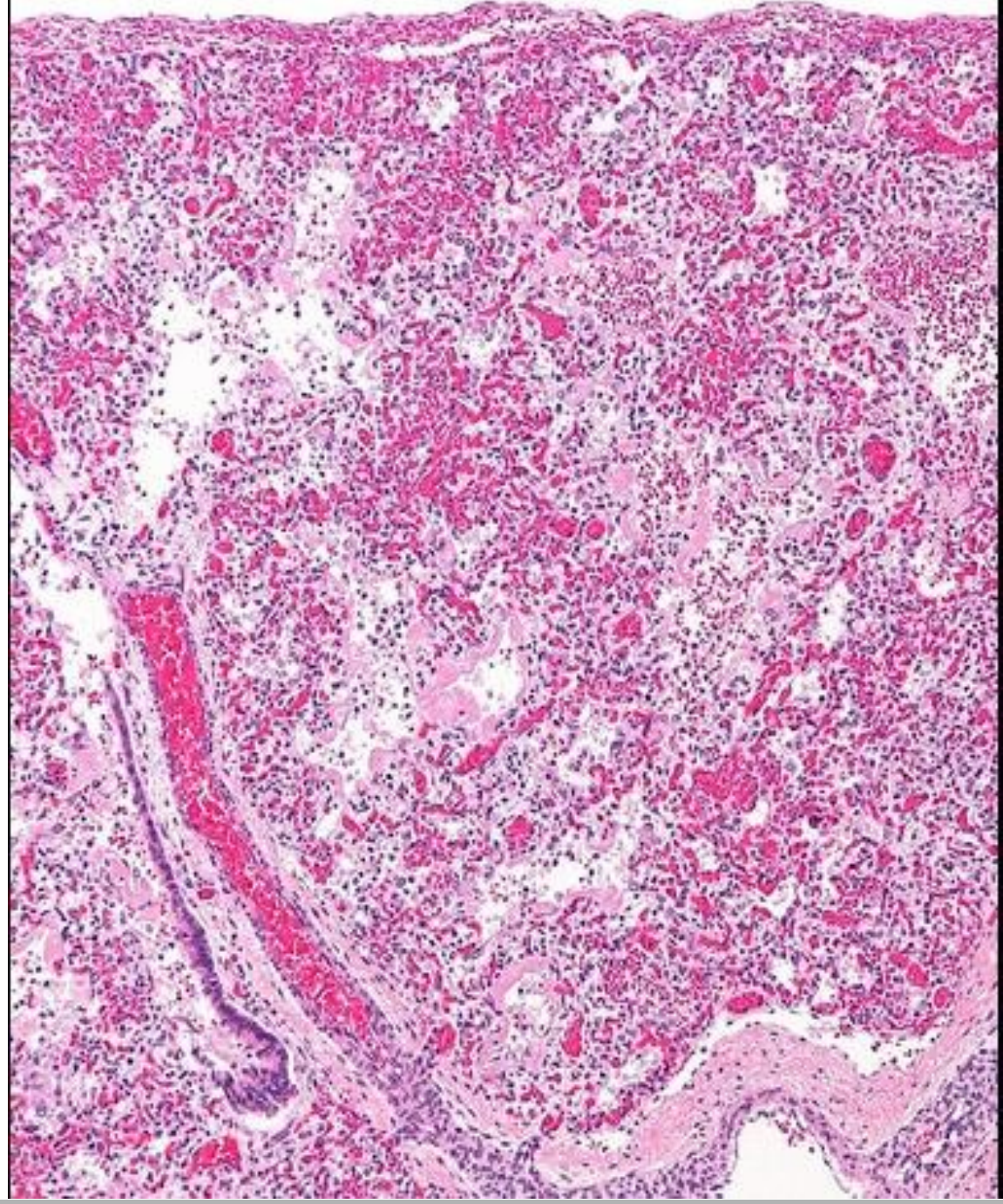
RBK och inflammatoriska celler invaderat lungan.

Den här lungan **kan inte brytas upp med tryck.**

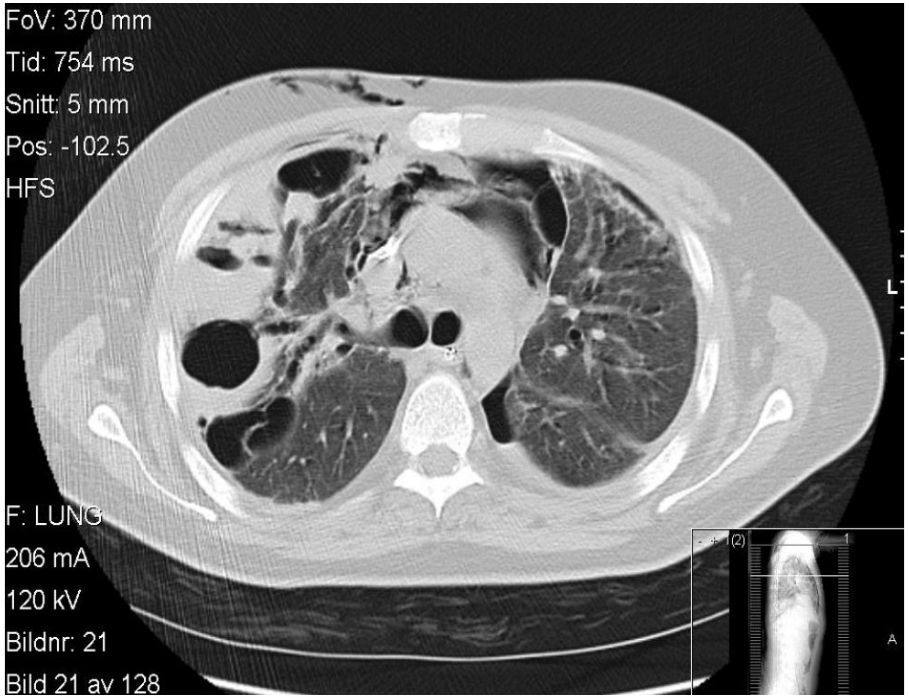
→ kan inte rekryteras

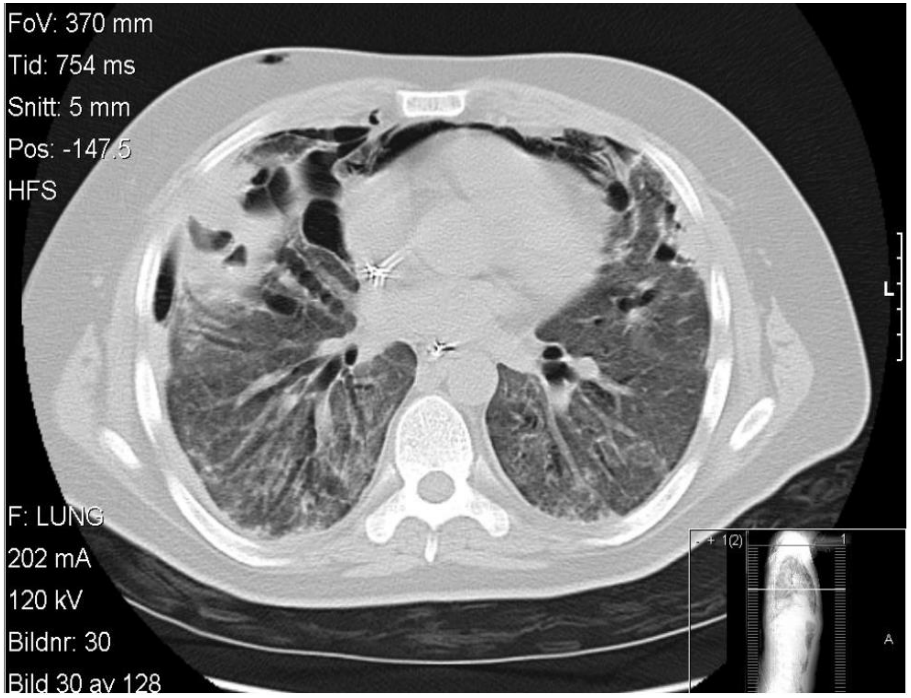
Bara ges tid …

”En lunga utan underliggande patologi vid insjuknande kommer att läka om den bara får tid.”
Dr Michael Hines
New Orleans, USA

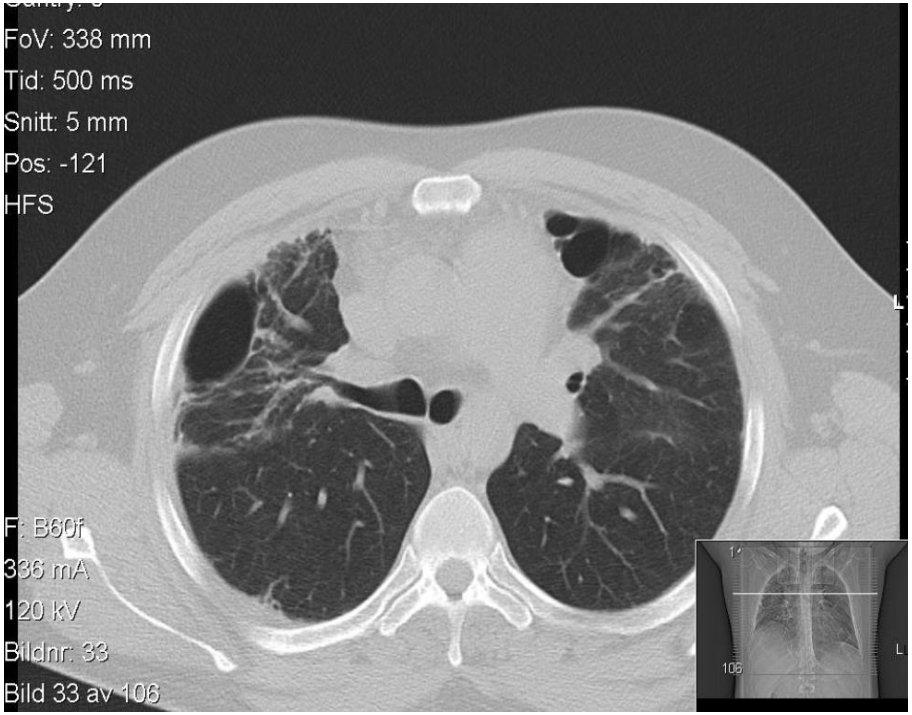


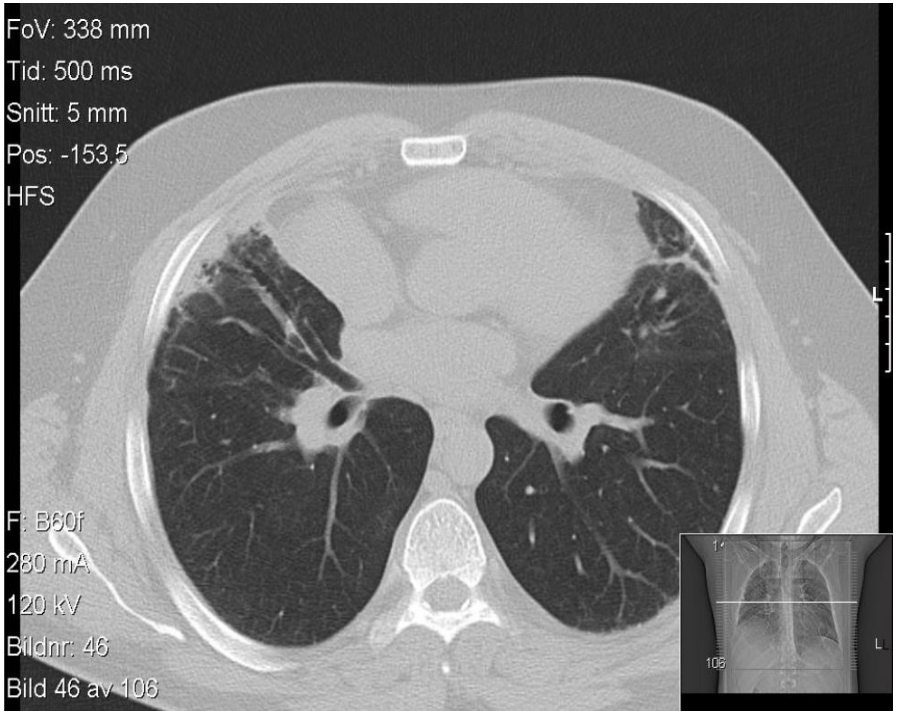
PostECMO-lunga



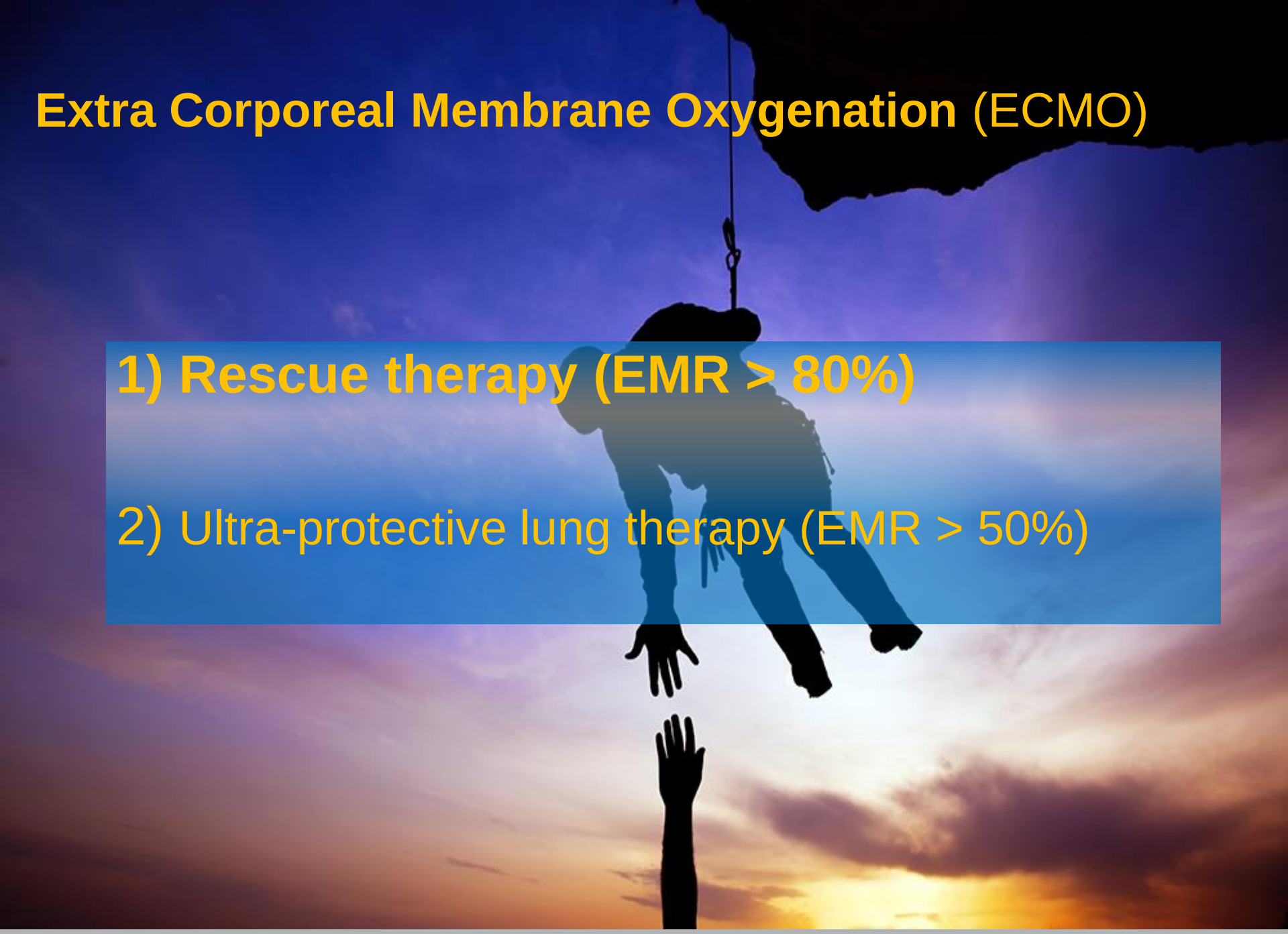


PostECMO-lunga






Cirkulatoriskt
Höger/vänster hjärtsvikt
Ino-pressorer
Ino-dilatorer
Vätskor
Laktat
ECMO
Ventilatoriskt
Ventilatortryck
O_2-diffusion
CO_2-retention
Bukläge
Infektionskontroll
A och Ω
Lever
DIC
CNS
IAH
ACS
Gastropares
Njursvikt
Vätskebalans
Metabola störningar
Benmärg



Extra Corporeal Membrane Oxygenation (ECMO)

1) Rescue therapy (EMR > 80%)

2) Ultra-protective lung therapy (EMR > 50%)

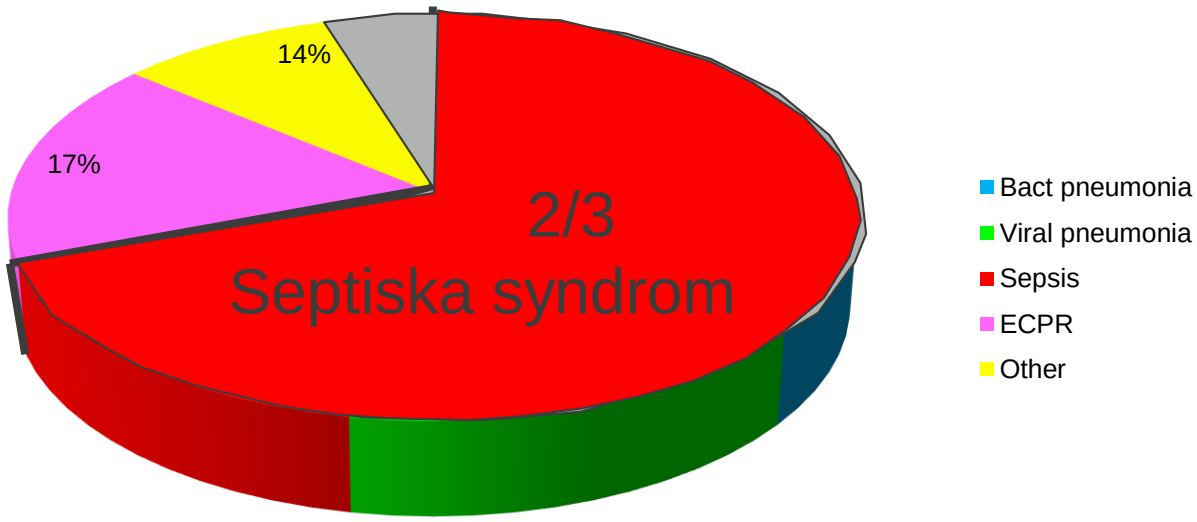
Lungsvikt o/e hjärtsvikt

Akut sjukdom - potentiellt reversibelt

Bridge till LungTX/HjärtTX; bridge; ?

***Elektiv* luftvägskirurgi**

Patienter vid ECMO Center Karolinska



Source: ESLO registry (ICD 9)

Ett av de 350-400 inkommande samtalen per år ger följande tips ....

Väcka/Relaxera

Respiratortryck/dead space

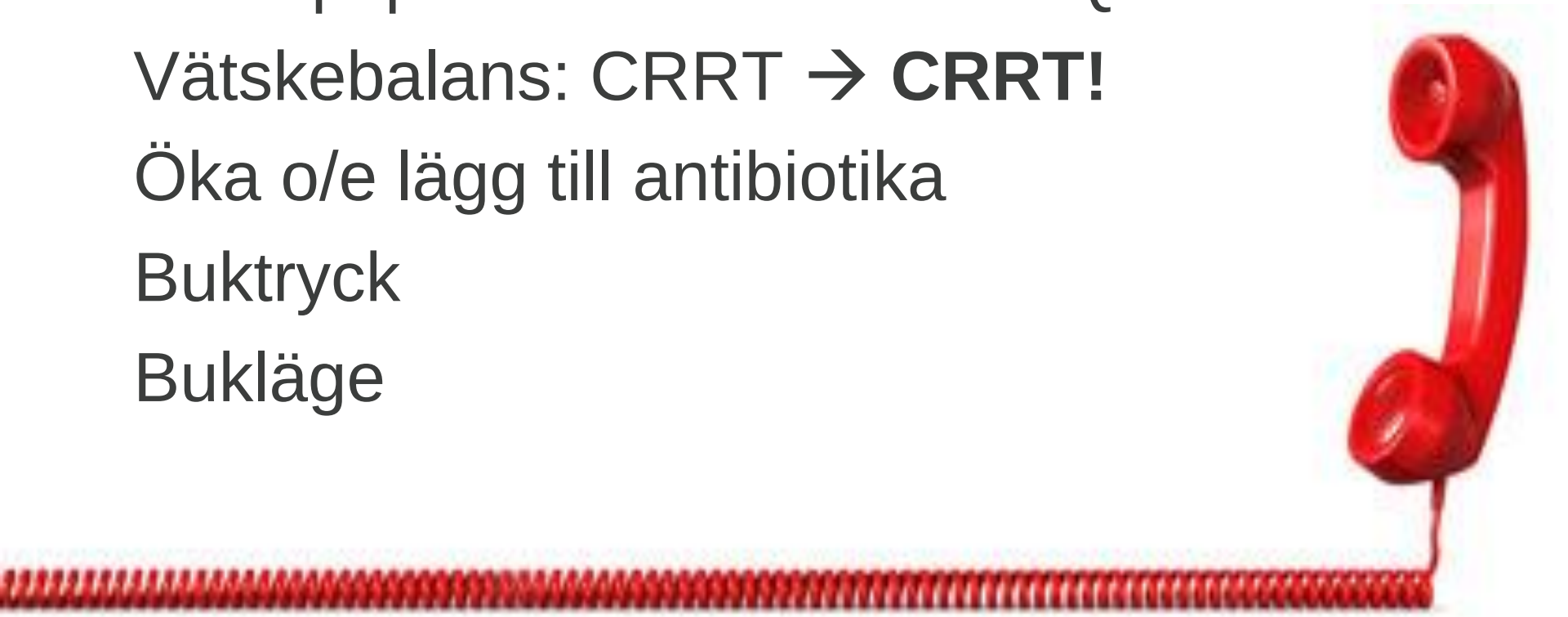
Inotropi/pulmonell resistens V/Q

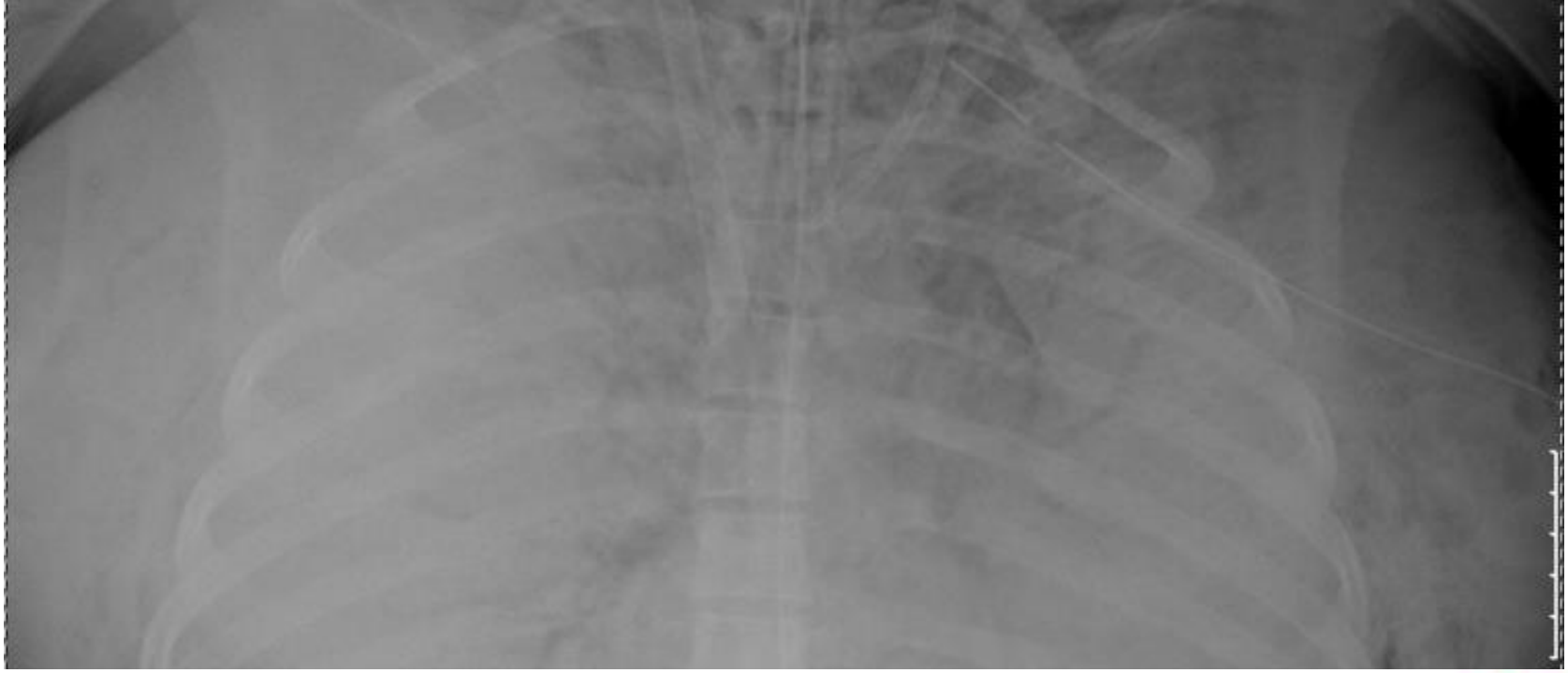
Vätskebalans: CRRT → **CRRT!**

Öka o/e lägg till antibiotika

Buktryck

Bukläge

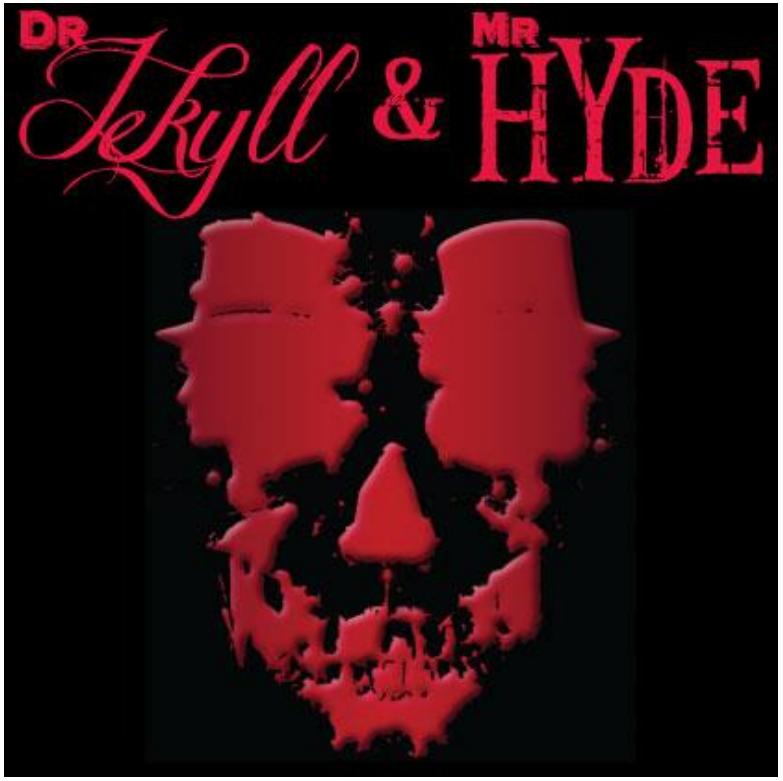




FiO_2 0.9 -1.0/p_aO_2 11-12 kPa (100 mmHg)
pH 7.1-7.2
p_aCO_2 8-10-12 kPa
Eskalerande vasoaktivt stöd

Vågar inte bukläge?
Laktat?
EKO?

Patienten glider mig ut händerna!
Behöver prata med någon …



<u>MISSA INTE</u>

Cytotoxisk hjärtsvikt

i.e. Septisk kardiomyopati

ECMO indikation!

Mycket god prognos

Ofta kort vårdtid, m: 4.5 d*

Lätt att missa - ”*ECMO är ju när Respen inte räcker*”

**) Bein, EuroELSO 2015, Regensburg.*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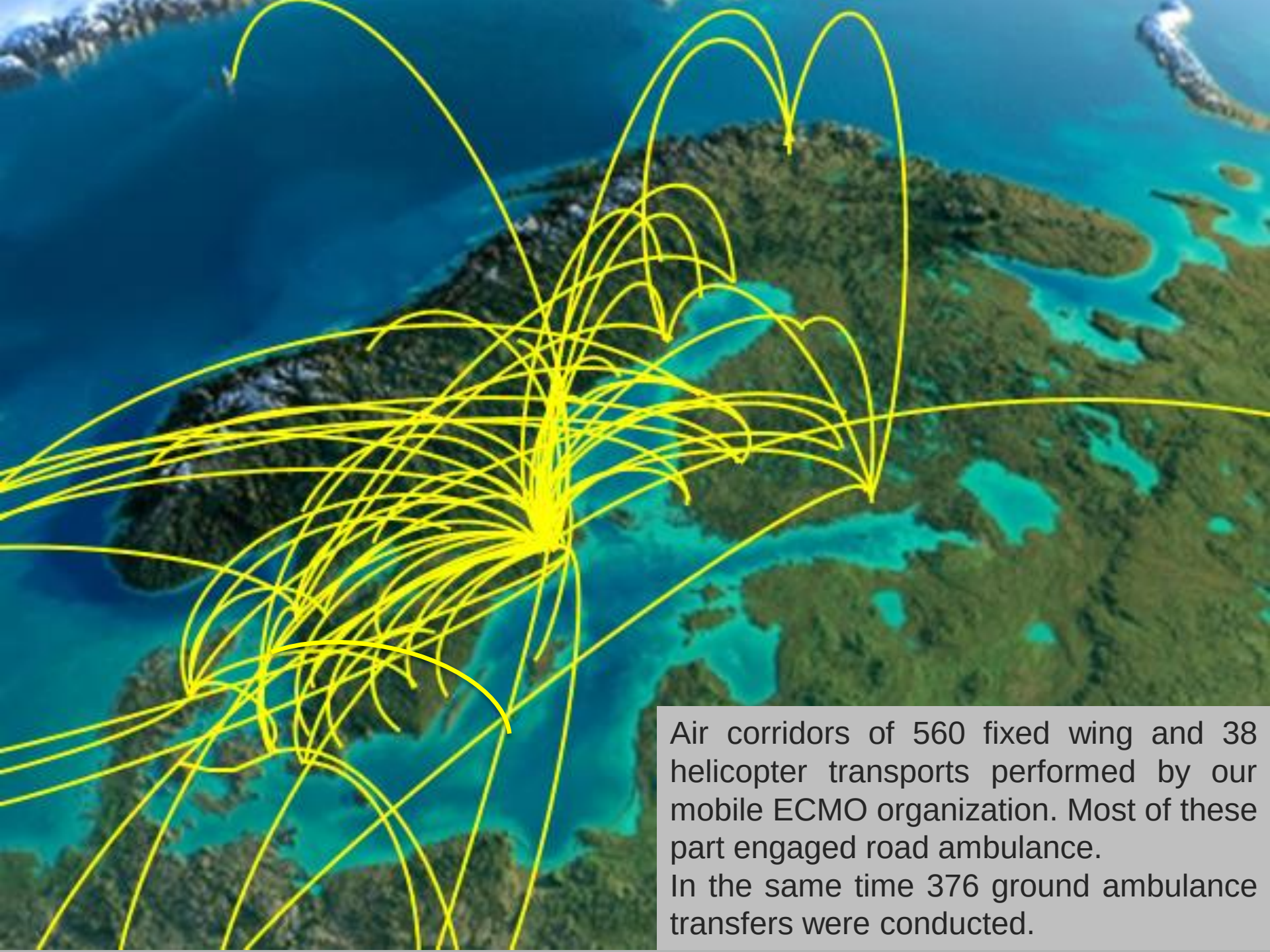


Air corridors of 560 fixed wing and 38 helicopter transports performed by our mobile ECMO organization. Most of these part engaged road ambulance.
In the same time 376 ground ambulance transfers were conducted.

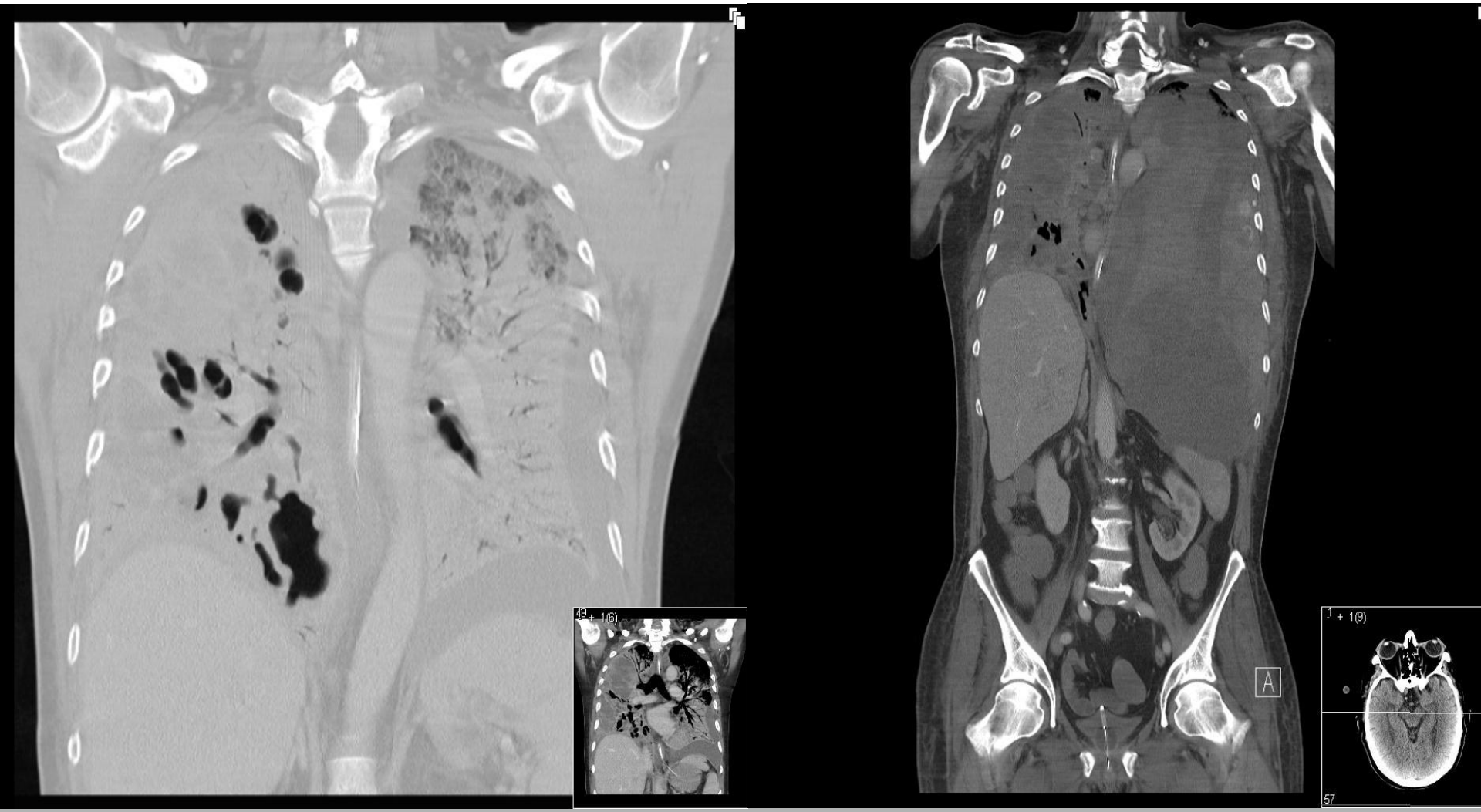

Happens

Trombotiska embolier
Blödningar

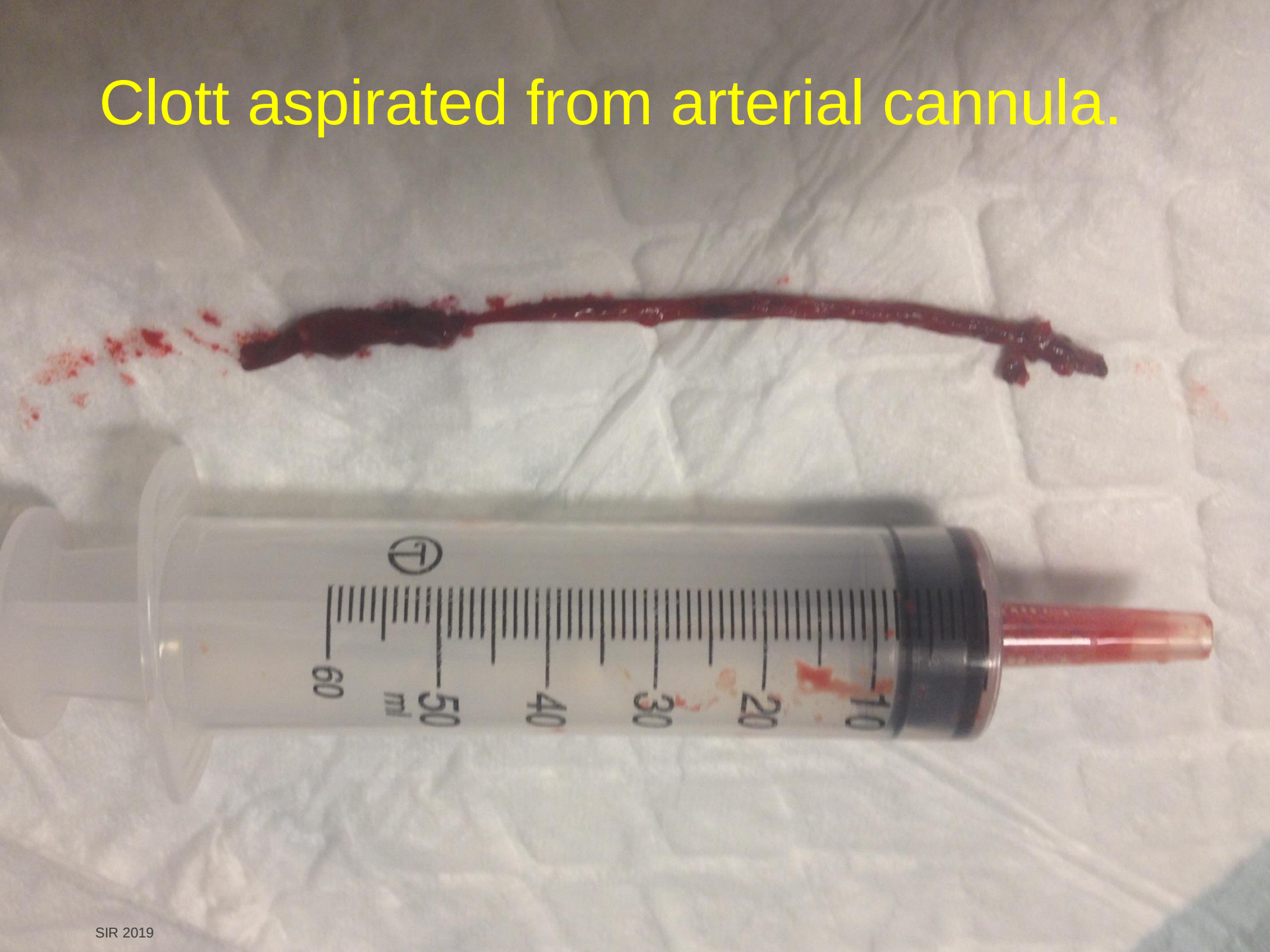
Behandlingen: antikoagulation
Sjukdomen *per se:* Septiska embolier

A 3 m/m pleural drainage:

20 liters of bleeding in first 4 operations, and a total of 13 thoracotomies!



Clott aspirated from arterial cannula.

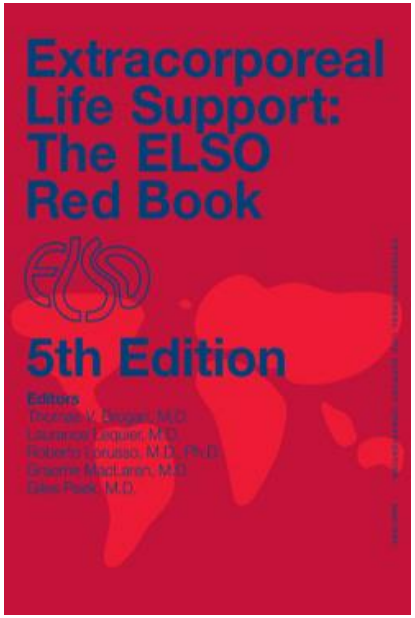


Brain Magnetic Resonance Imaging Findings in Pediatric Patients Post Extracorporeal Membrane Oxygenation

Pinto, Venessa L.[*]; Pruthi, Sumit[†]; Westrick, Ashly C.[§]; Shannon, Chevis N.[§]; Bridges, Brian C.[#]; Le, Truc M.[#]

ASAIO Journal: November/December 2017 - Volume 63 - Issue 6 - p 810–814
doi: 10.1097/MAT.0000000000000580
Pediatric Circulatory Support

Mixed pediatrisk pop.
13/47 (28%): 8 ischemic, 2 bleeding, 3 mixed.



50% thromboembolic events - autopsy material

10% DVT in cannulated vessel.

Incidence CNS infarction 2-4% (mort 70-77%)
Incidence CNS hemorrhage 1-3% (mort 80-90%)

Fletcher Sandersjöö *et al. Journal of Intensive Care* (2017) 5:27
DOI 10.1186/s40560-017-0223-2

Journal of Intensive Care

RESEARCH Open Access

Predictors of intracranial hemorrhage in adult patients on extracorporeal membrane oxygenation: an observational cohort study

Alexander Fletcher Sandersjöö[1,2*], Jiri Bartek Jr.[1,2,3], Eric Peter Thelin[2,4], Anders Eriksson[5], Adrian Elmi-Terander[1], Mikael Broman[5,6] and Bo-Michael Bellander[1,2]

253 pts, 2005-2016

21% av vuxna drabbas av ICH, 81% avlider (nonICH 28%)

Riskfaktorer:
antitrombotisk behandling innan ECMO
lågt TPK
SOFA score
spontan extrakraniell blödning

Online version at http://www.minervamedica.it

Minerva Anestesiologica 2017 July;83(7):762-72
DOI: 10.23736/S0375-9393.17.11835-3

REVIEW

Extracorporeal CO_2 removal in critically ill patients: a systematic review

Fabio S. TACCONE [1], Maximilian V. MALFERTHEINER [2], Fiorenza FERRARI [3], Matteo DI NARDO [4], Justyna SWOL [5], Lars M. BROMAN [6], Leen VERCAEMST [7], Nicholas BARRETT [8], Federico PAPPALARDO [9], Jan BELOHLAVEK [10], Thomas MUELLER [2], Roberto LORUSSO [11], Mirko BELLIATO [12] *
on behalf of EuroELSO Workgroup "Innovation on ECMO and ECLS"

intubation, however the ICU-LOS and survival was not influenced by $ECCO_2R$ when compared to controls.
CONCLUSIONS: In COPD patients, a significantly reduced need for endotracheal intubation was reported. However, the use of $ECCO_2R$ has not shown significant improvement on the outcome of critically ill patients in the reviewed studies. Therefore appropriately powered, randomized, controlled studies are urgently needed.

Idag ingen bevisad fördel – pga komplikationsfrekvensen

Svenska Intensivvårdsregistret

SIR

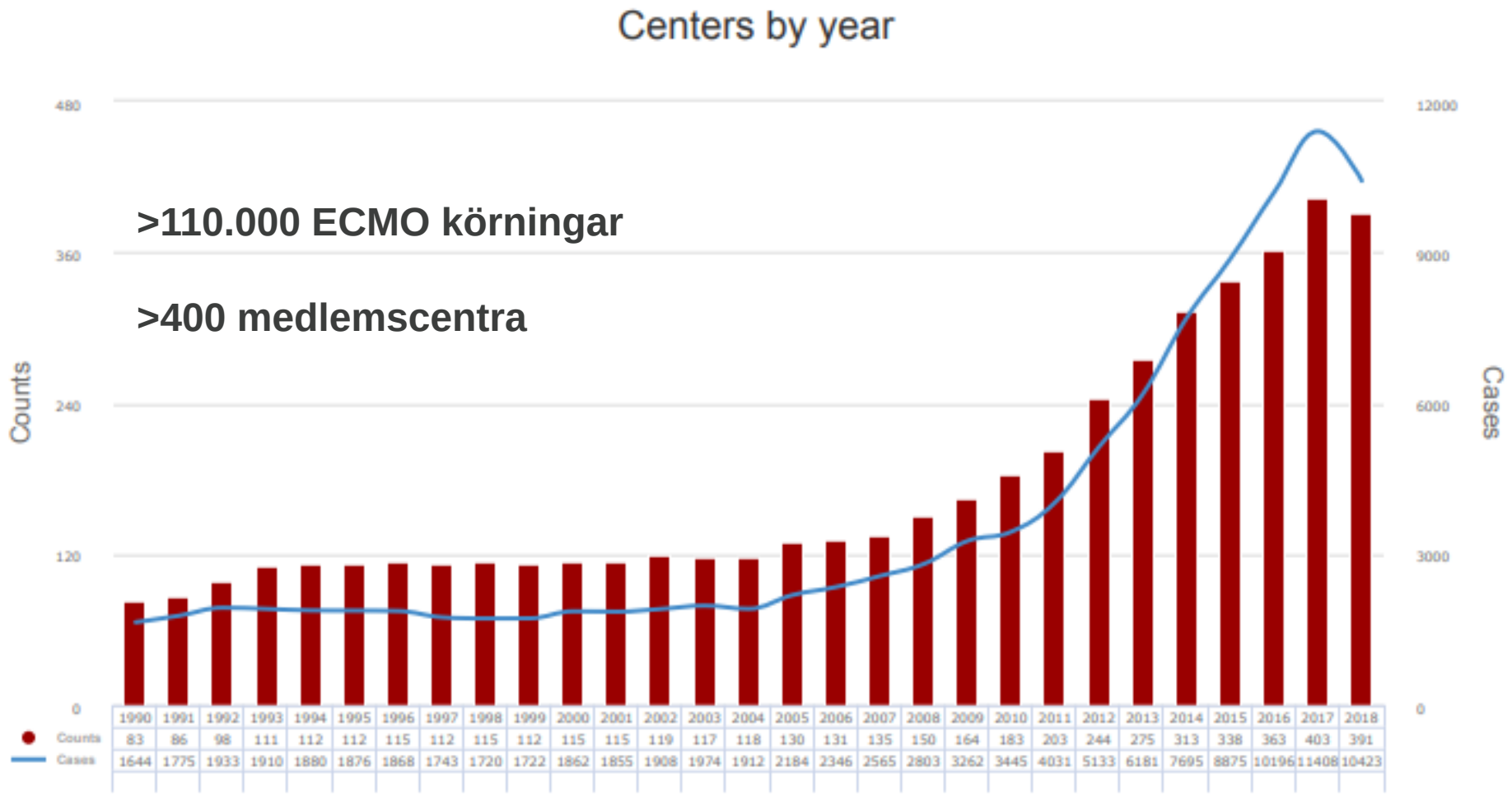
ELSO Registry, Ann Arbor, MI, USA

ECMO Centrum Karolinska

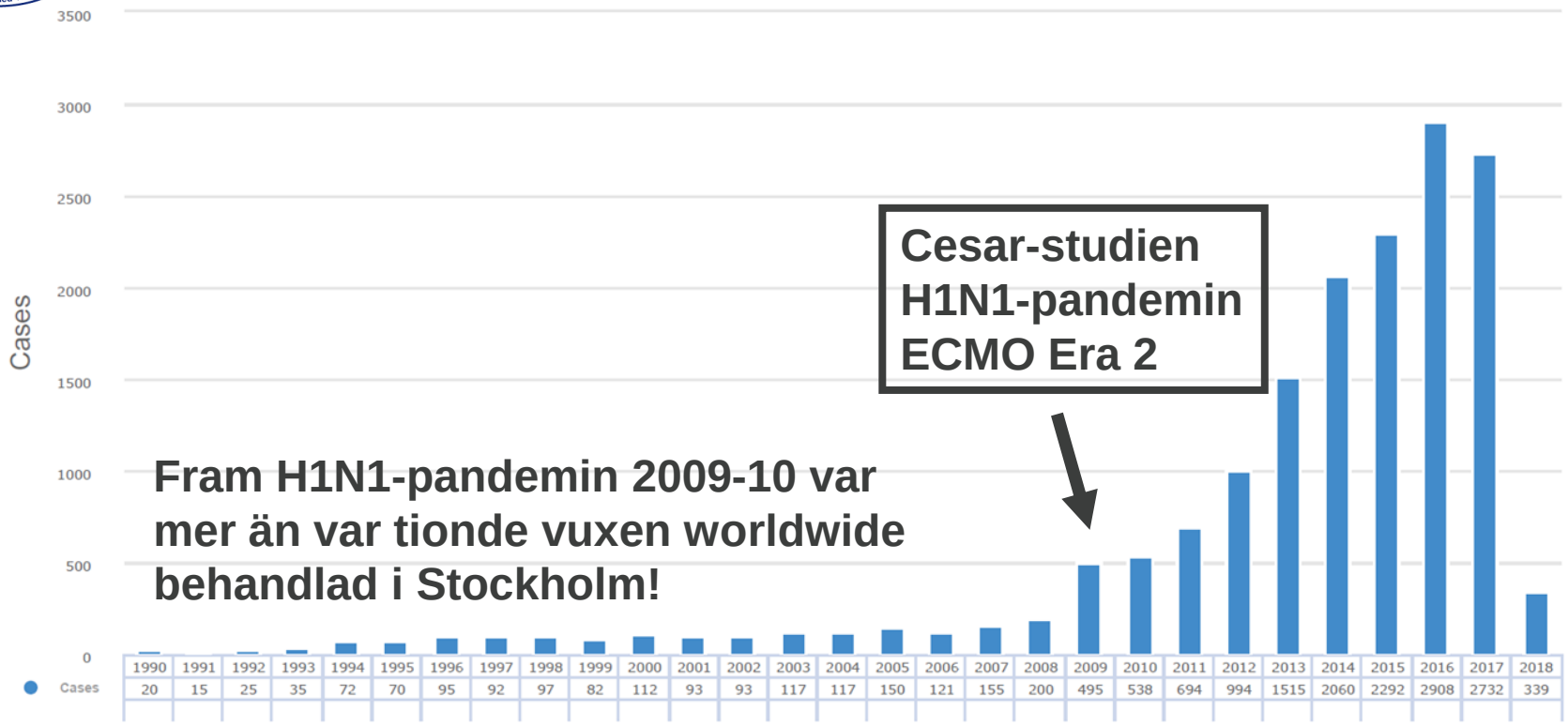
PasIVA, extenderat 2012-tv
Accessdatabas 1987- tv

ELSO centers

ELSO centers



Adult respiratorisk ECMO



Säljer vi samma “ECMO-product”?

Online version at http://www.minervamedica.it
Minerva Anestesiologica 2017 April;83(4):424-5
DOI: 10.23736/S0375-9393.16.11766-3

Veno-Venous ECMO in Europe: are we all speaking the same language?

Dear Editor,

In the last decade, the use of Veno-Venous (VV) ECMO to treat acute respiratory failure (ARF) has increased, fuelled by the promising results acquired during the H1N1 pandemic influenza.

To describe the current differences in VV ECMO practice in Europe, we have conducted a cross sectional international survey, using an electronic questionnaire

ing doubts about the opportunity and the cost effectiveness of such a diffusion of mobile ECMO teams.[3]

Our survey depicts a scenario in which the management of patients on VV ECMO is remarkably different among various centers and it might be asked whether this marked heterogeneity turns into different results. While waiting for the development of a sound knowledge about the proper applications of this technique, VV ECMO should be employed in high volume centres, encouraging international cooperation and inter-hospital data sharing.[4, 5]

Federico PAPPALARDO [1], Andrea MONTISCI [2], Anna SCANDROGLIO [1], Mirko BELLIATO [3], Maximilian MALFERTHEINER [4], Mikael BROMAN [5], Piero DAVID [6], Roberto LORUSSO [7], Fabio TACCONE [8], Francesca BROCCATI [9], Matteo DI NARDO [9] *

53 europeiska centers – stor skillnad i hur vi gör.
Oklart om detta påverkar resultaten.

-- --- --- --

‘Number per center’ påverkar mortalitet och morbiditet.


Center Volume Outcome

Kvalitetsstämpel?

Extracorporeal Life Support Organization (ELSO)

Center volume for ECMO

Position Paper for the Organization of Extracorporeal Membrane Oxygenation Programs for Acute Respiratory Failure in Adult Patients.

Combes A, et al. The International ECMO Network (ECMONet). Am J Respir Crit Care Med 2014;190(5):488-496.

- Minimum 20 ECMO-körningar per år behövs för att bygga upp och bibehålla kompetens
- Minst 12 respiratoriska ECMO krävs för “good outcome“ på centra med totalt minst 30 runs/år (lung + hjärta)
- Barn och Neonatal: minst 20-22-30 runs/år [1-3]

Freeman CL, Bennett TD, Casper CC, et al. Pediatric and neonatal extracorporeal membrane oxygenation: Does center volume impact mortality? *Crit Care Med* 2014;42:512-519.
Barbaro R, Odetalo F, Kidwell k, Bartlett R, Davis MM, Annich G. Association between hospital extracorporeal membrane oxygenation (ECMO) volume and mortality. Am J Resp Crit Care Med 2015; 191(8):894-901

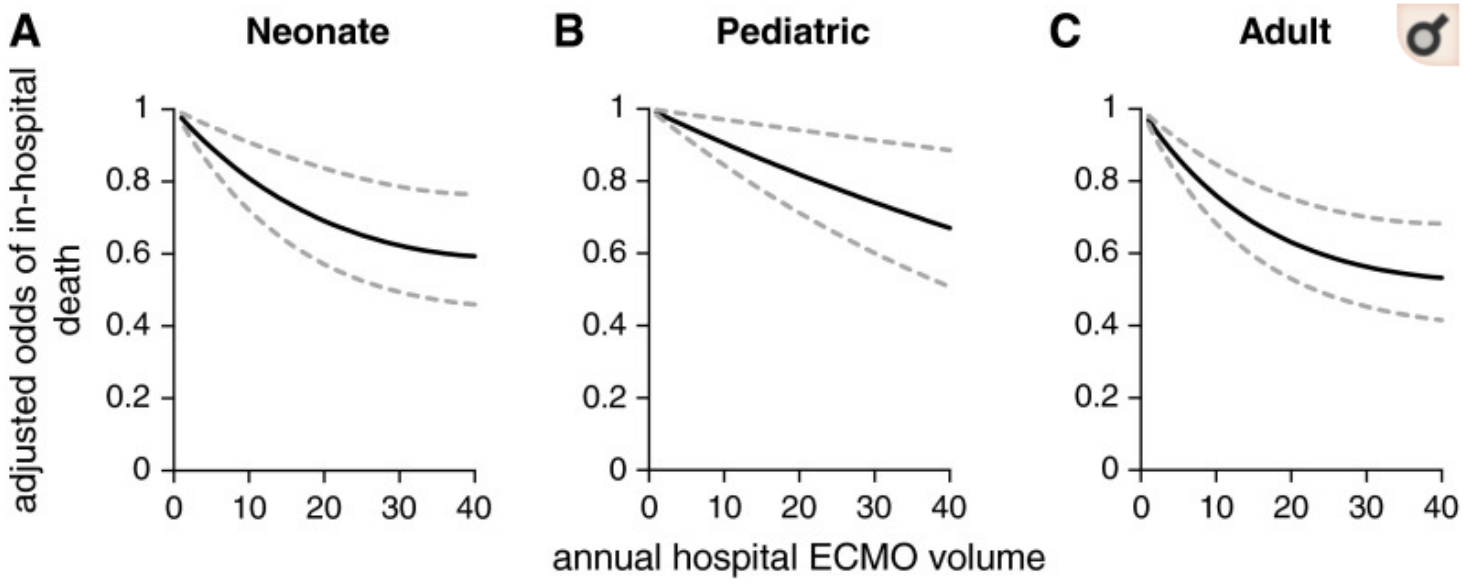
Association of Hospital-Level Volume of Extracorporeal Membrane Oxygenation Cases and Mortality. Analysis of the Extracorporeal Life Support Organization Registry
Barbaro et al. Am J Resp Crit Care Med 2015; 191(8):894-901

- **56.000 pts** at 290 centers

Adult rECMO: Low volume centers (<6/year) vs. high-volume centers (>30/year): **OR for death 0.61** (CI 95% 0.46-0.80)

Higher Volumes, Better Outcomes: The End or Just the Beginning of the Story for Extracorporeal Membrane Oxygenation?
Fan E and Brodie D. *Editorial*. Am J Resp Crit Care Med 2015; 191(8)

Figure 2.



Adjusted odds of in-hospital mortality among patients receiving ECMO support when volume is modeled continuously, 1989–2013. Hospital ECMO volume is defined as the age group–specific number of patients treated with ECMO per year. The adjusted odds of death are presented relative to the lowest-volume hospitals in each age group. The *dashed lines* represent the upper and lower bounds of the 95% confidence intervals for the estimated volume-specific point estimates. When volume is modeled as a continuous variable the *P* values are as follows: (*A*) neonatal, $P < 0.001$; (*B*) pediatric, $P = 0.006$; and (*C*) adult, $P < 0.001$. ECMO = extracorporeal membrane oxygenation.

Barbaro et al. Am J Resp Crit Care Med 2015; 191(8):894-901

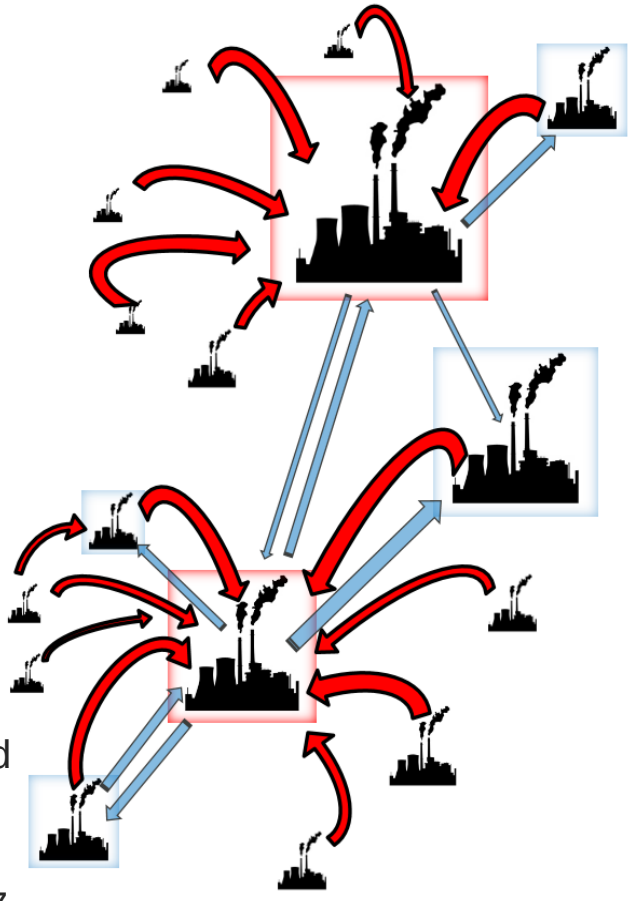
Organisation av adult rECMO

Ett högvolymcentra för befolkningsunderlag om 5-15 miljoner.

"Hub-and-Spoke model"
Skapa nationella/regionala nätverk med "perifera" enheter med kunnig personal kan kanylera och driva ECMO-behandling i timmar/något dygn till mobilt ECMO-team överför patienten till högvolymcentra.

Detta, med befolkningens bästa i fokus, för att till lägsta kostnad optimera resursutnyttjande, minska komplikationer och sjuklighet med ökad överlevnad.

Högvolymcentrat organiserar och driver ECMO-transport service 24/7.



References
Combes, et al. AJRCCM 2014;190(5):497-508; Karagiannidis C, et al. Intensive Care Med 2016;42:889-96; Karamlou T et al. J Thorac Cardiovasc Surg 2013;145:470-5; Freeman CL, et al. Crit Care Med 2014;42:512-9; Barbaro RP, et al. Am J Respir Crit Care Med 2015;191:894-901; Broman LM. J Thorac Dis 2017;9(9):3425-9. doi: 10.21037/jtd.2017.07.93; Pappalardo F, et al. Minerva Anestesiol 2017;83(4):424-5; Broman LM. J Thorac Dis 2018, accepted 2018-05-15.


GERMAN VOLUME TRAINING
WILL BREAK YOU

Tyskland

Befolkning		83 M
ECMO		ej reglerat
Venovenös rECMO	(vx)	2.200/år
	2,6/100.000 per år	
Antal centers		oklart
Centers >12 rECMO, >30 tot/år		oklart
Överlevnad	tot 38%; VA 34%; **VV 42%**	
Högvolymcentra överlevnad		70%

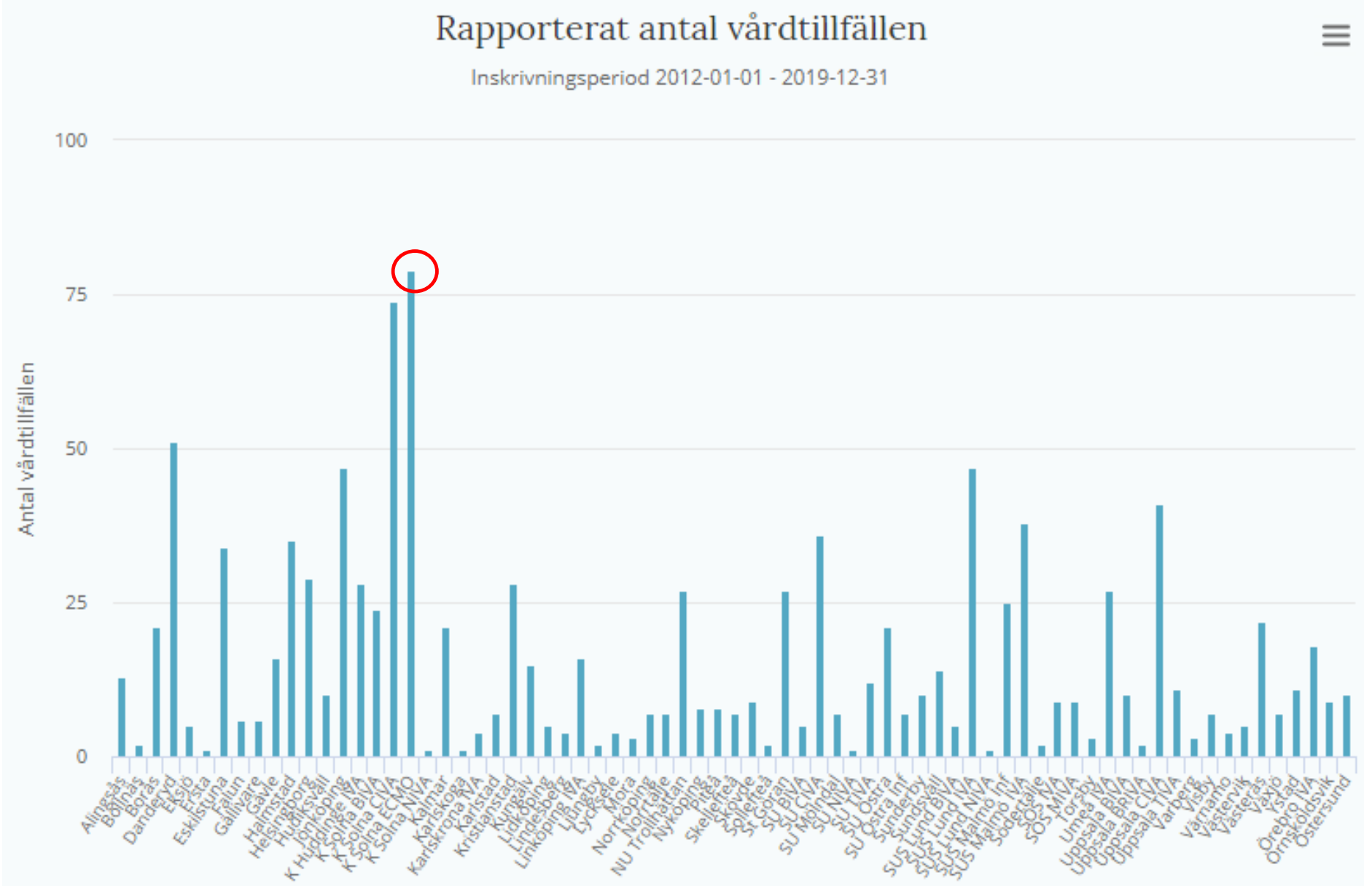
Sverige

Befolkning		10 M
ECMO		ej reglerat
Venovenös rECMO	(vx)	30/år
	0,3/100.000 per år	
Antal centers		6
Centers >12 rECMO, >30 tot/år		1
Överlevnad ECMO Centrum		88%

Karagiannidis C, et al. Intensive Care Med 2016;42:889-96.
Broman LM. J Thor Disease 2018; Doi 10.21037/jtd.2018.05.136

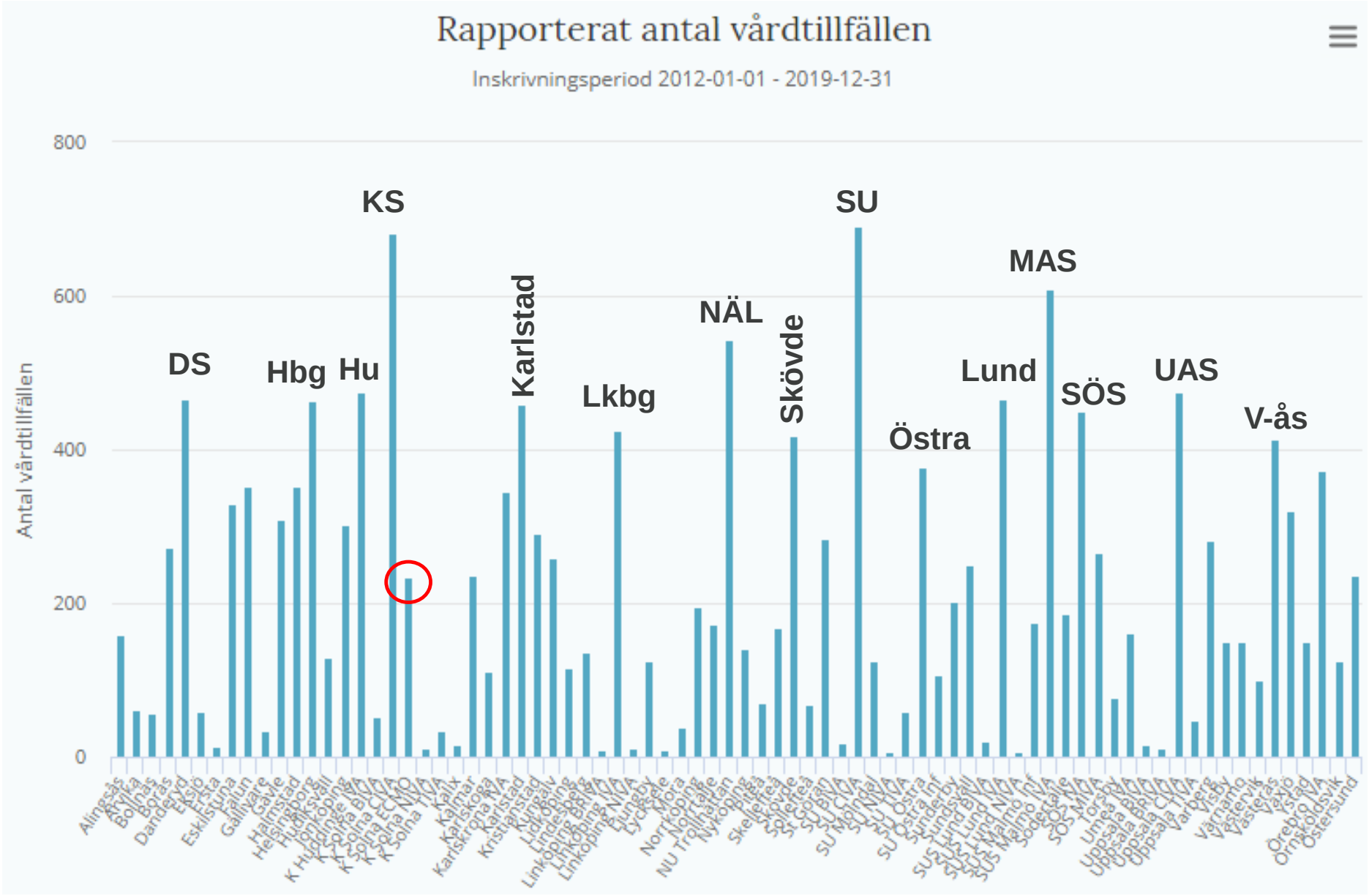
ARDS 2012-2019

SIR/utdataportal 2019-02-19 (icuregswe.org)



Septisk chock 2012-2019

SIR/utdataportal 2019-02-19 (icuregswe.org)



Tolka registerdata - svårt

- ThIVA
  - Dominerande hjärt-ECMO; postcardiotomi, hjärstopp/hjärtsvikt, LE, myokardit mm.
  - Vuxna
  - Annat diagnosspektrum avseende *cardiac* än ECMO Centrum
  - Alla registrerar inte till SIR
  - Registrerar till andra (icke öppna) register?
  - Venorartäriell (, venovenös)

- ECMO Centrum
  - Blandad neonatal/pediatrisk/vuxen, medicinsk och kirurgisk IVA
  - Dominerande respiratorisk ECMO; Sepsis/ARDS, mekonium, CDH, PPHN
  - Hjärt-ECMO (allt utom postkardiotomi)
  - Venovenös, venoartäriell, venevenoartäriell

Tidsperiod som rapporterats till SIR

Inskrivningsperiod 2013-01-01 – 2019-12-31

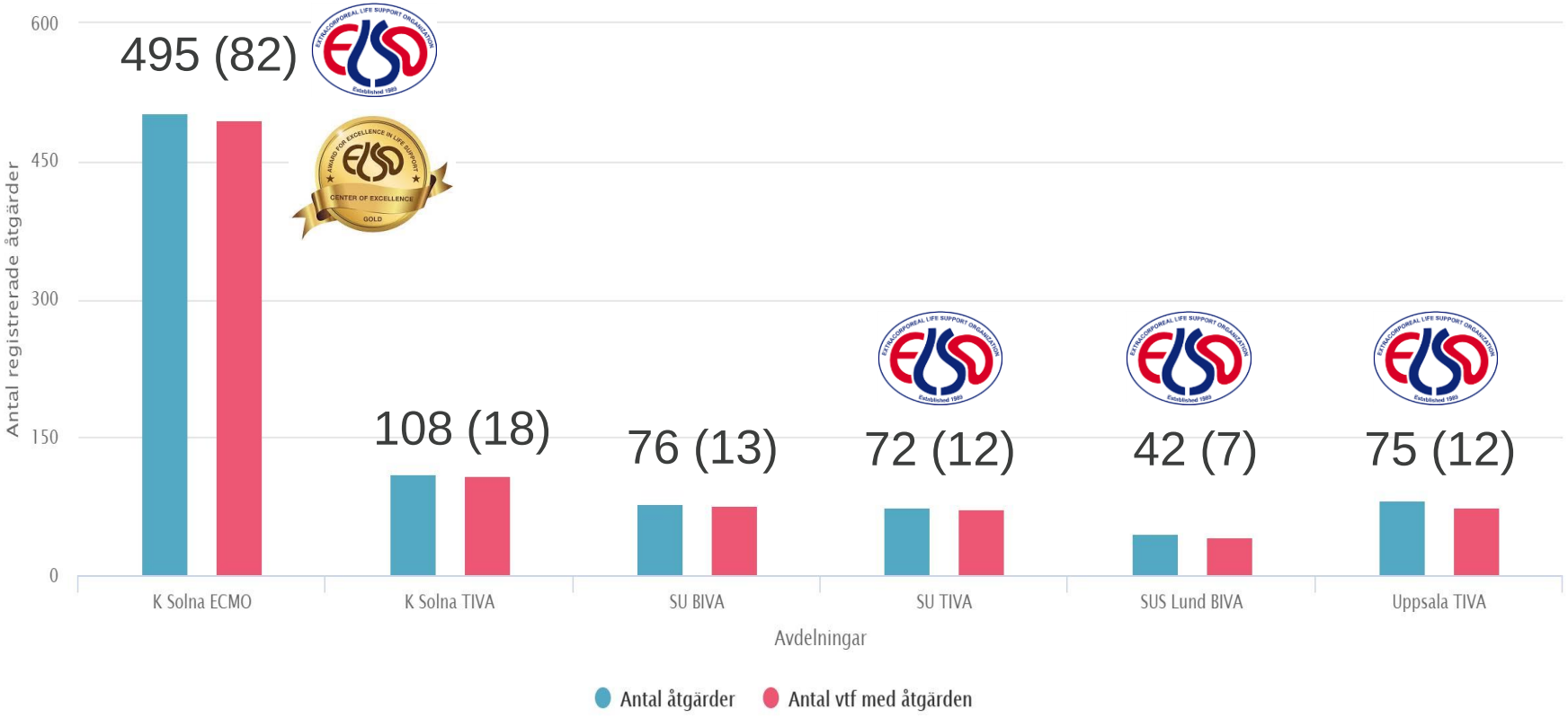
Tidsperiod som rapporterats till SIR

Inskrivningsperiod 2013-01-08 – 2018-12-29

ECMO – Antal registrerade åtgärder/vtf

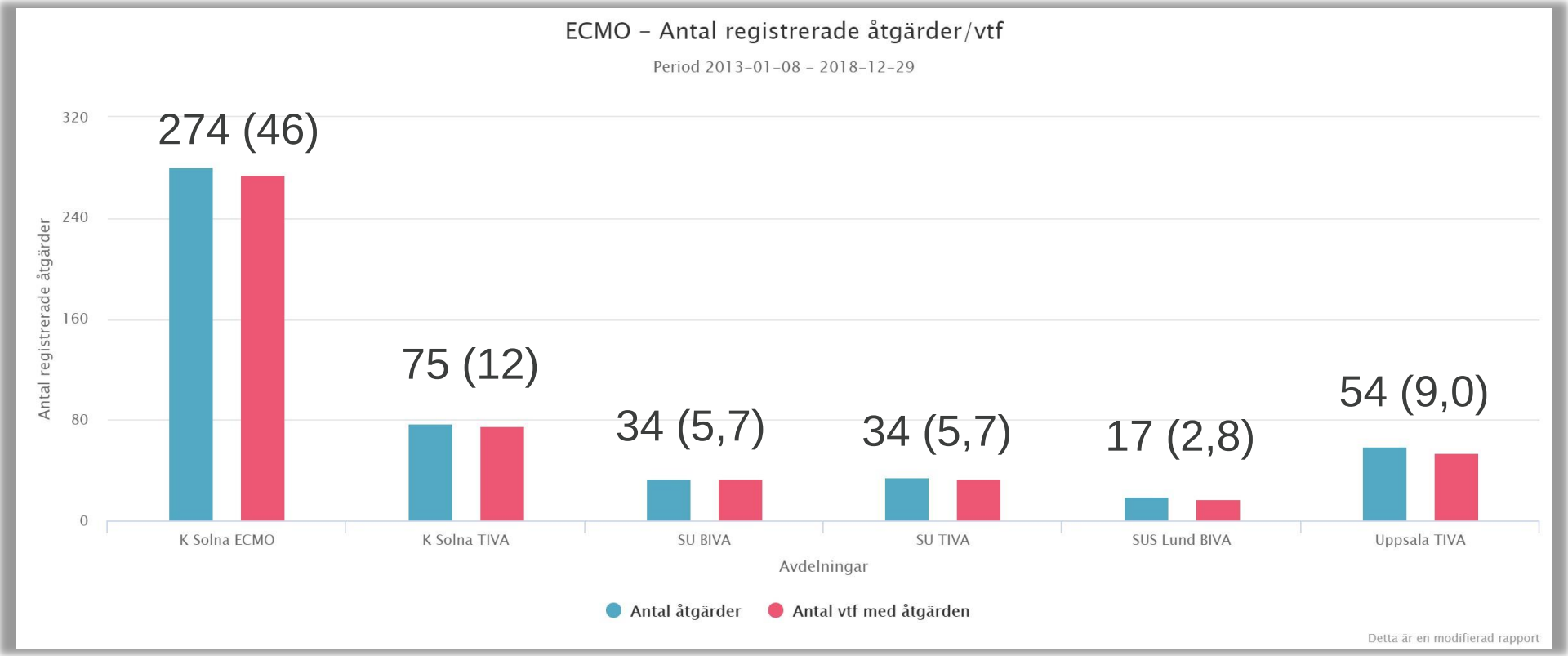
Period 2013-01-08 – 2018-12-29

Huvuddiagnos 'Alla'

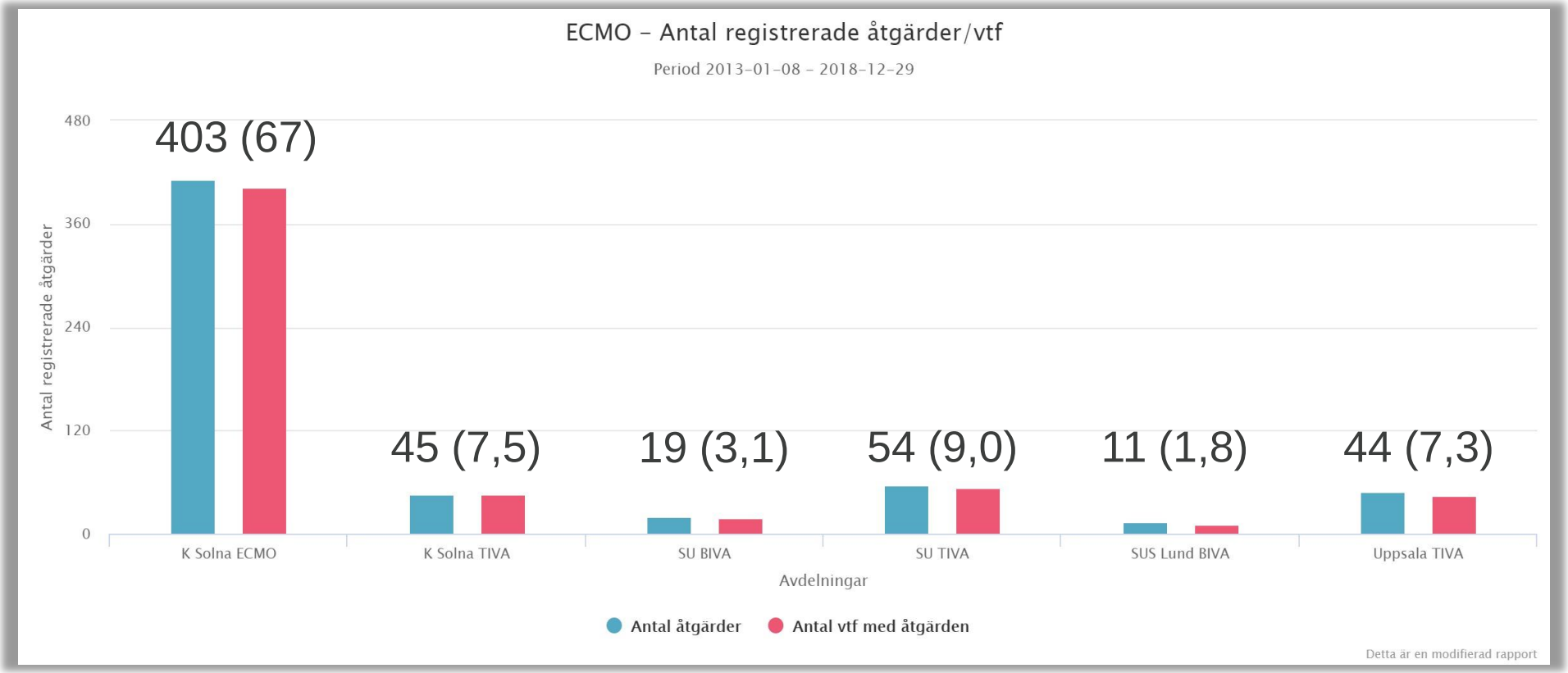


Detta är en modifierad rapport

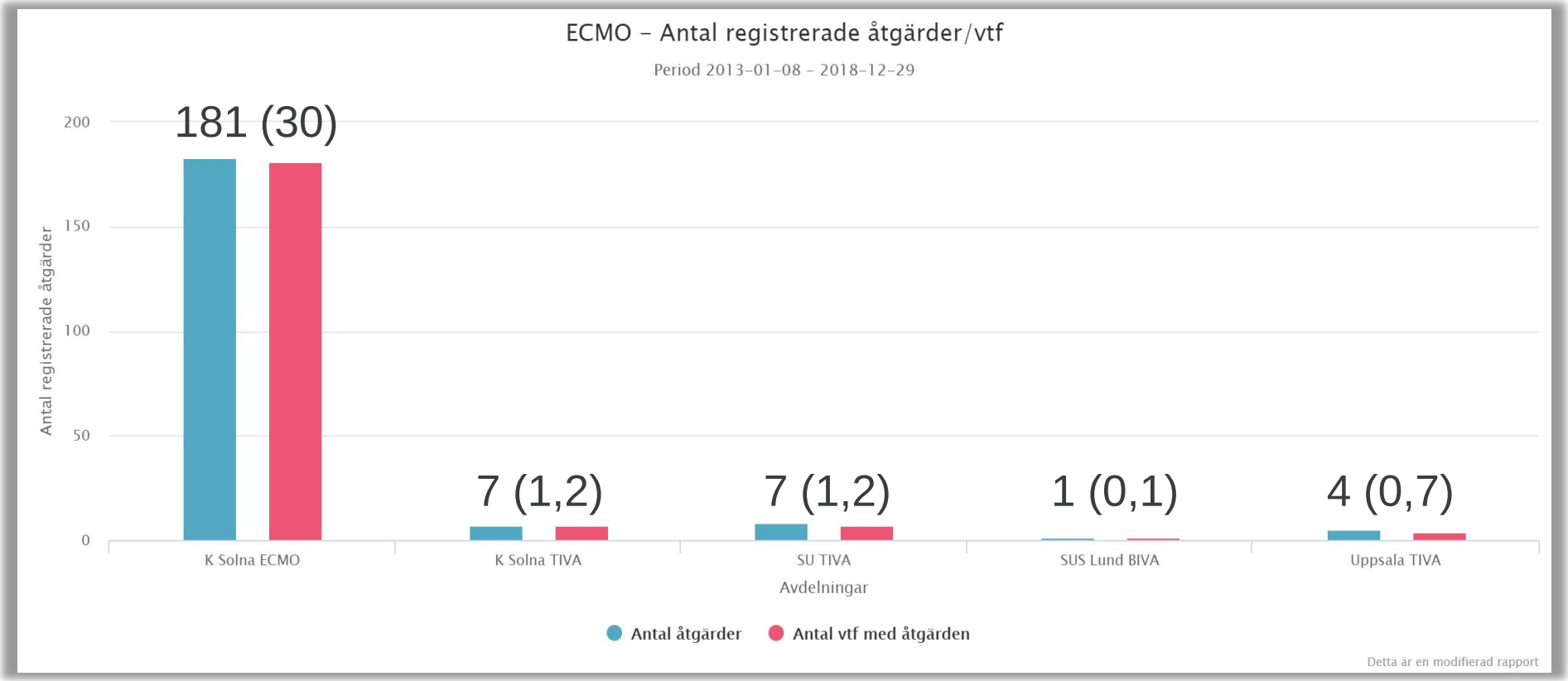
Huvuddiagnos *'Cirkulatorisk'*



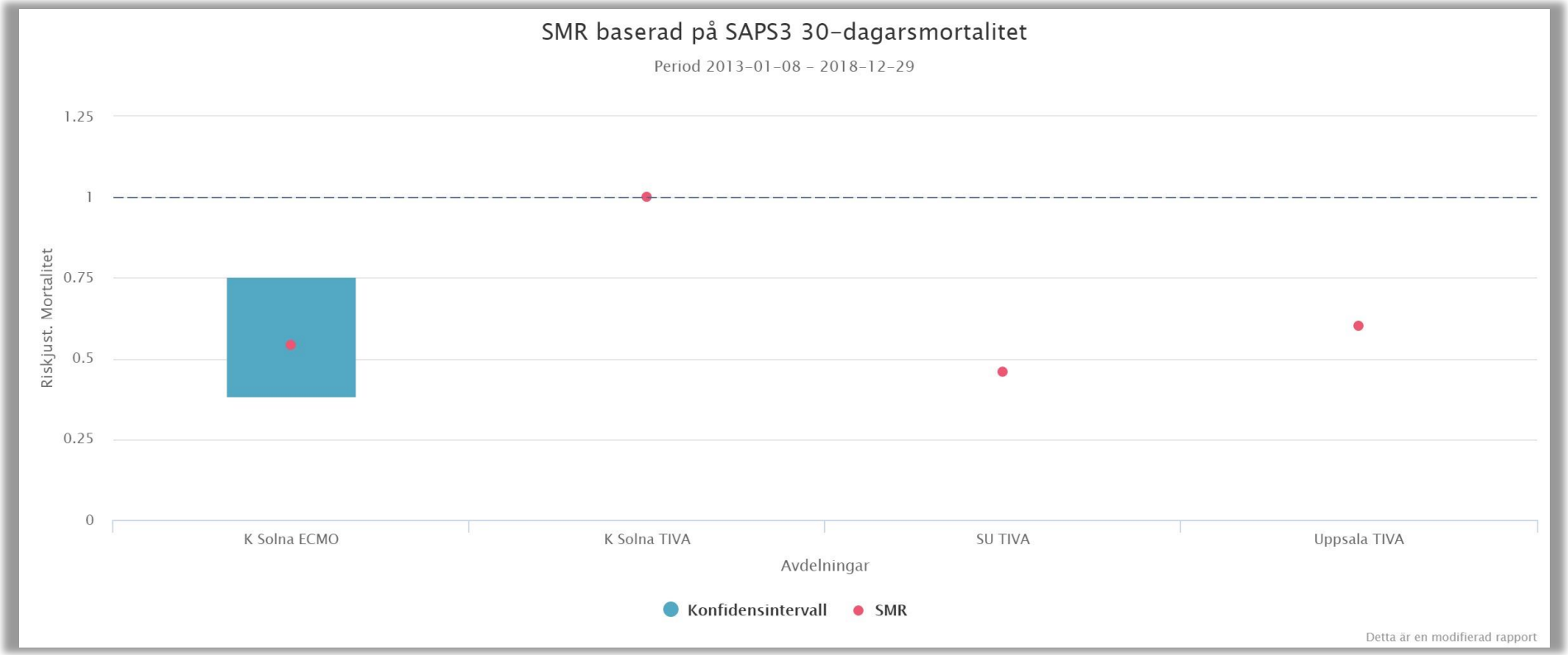
Huvuddiagnos *'Respiratorisk'*



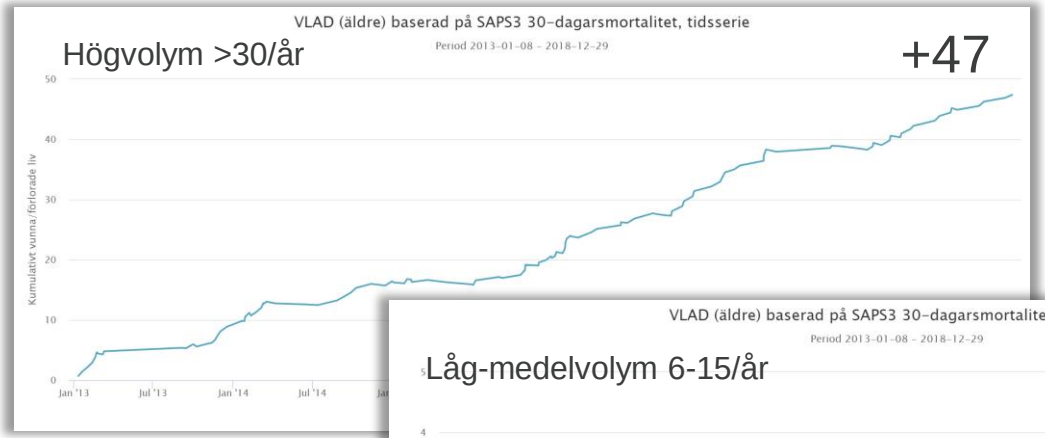
Intagningsorsak SAPS-3 *'Septisk chock'*

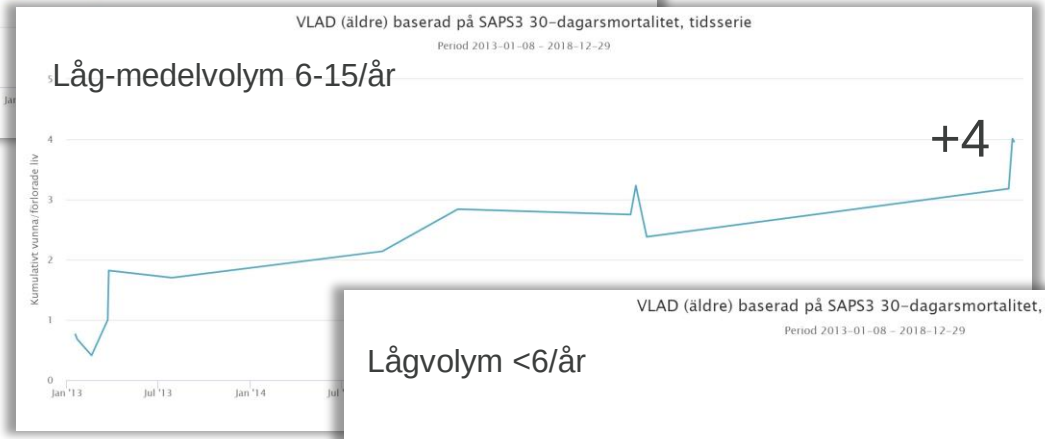


Intagningsorsak SAPS-3 *'Septisk chock'*

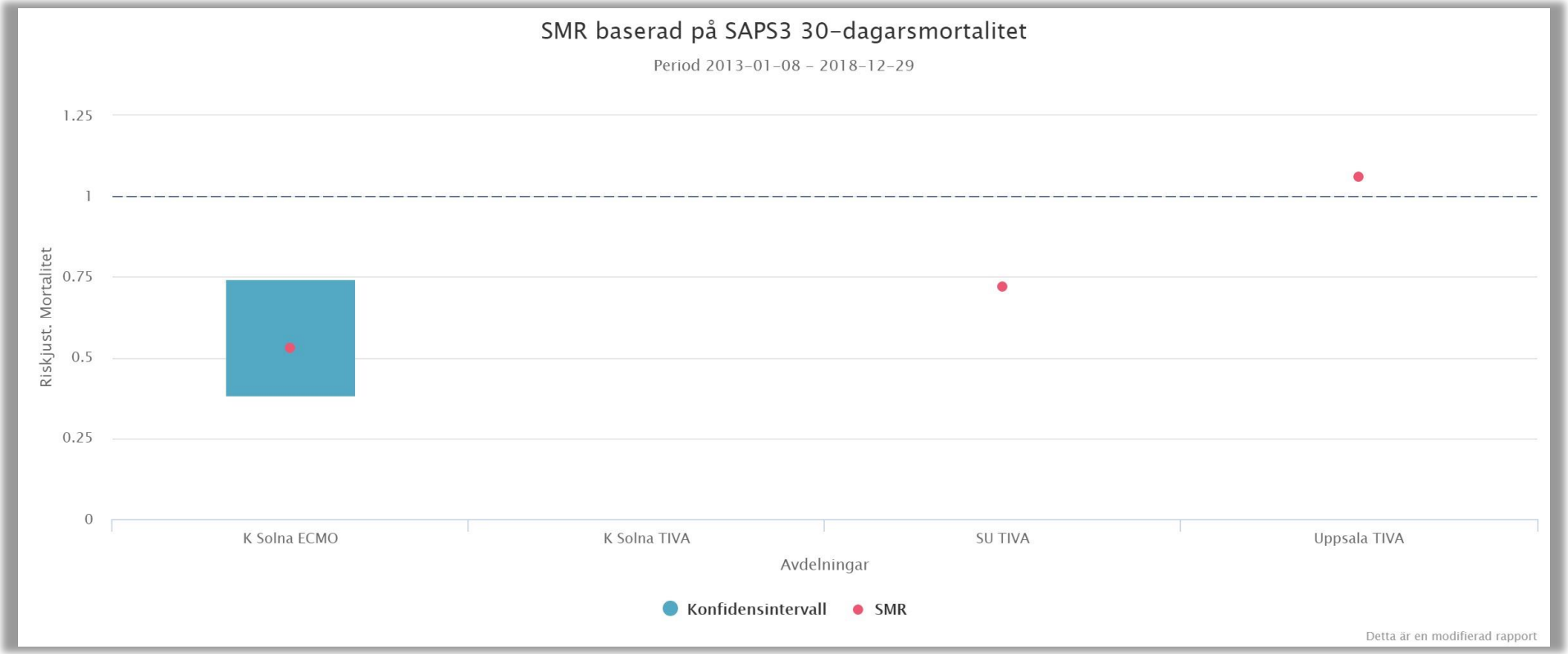


Intagningsorsak SAPS-3 *'Septisk chock'*

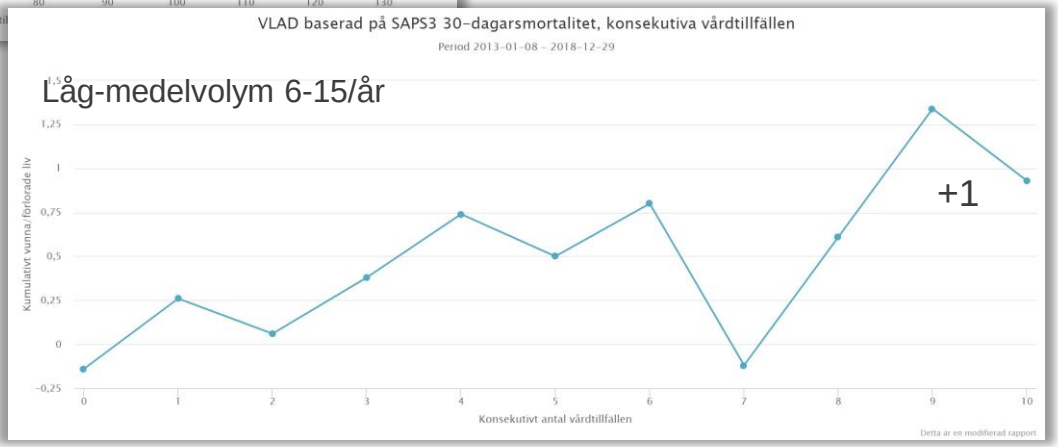




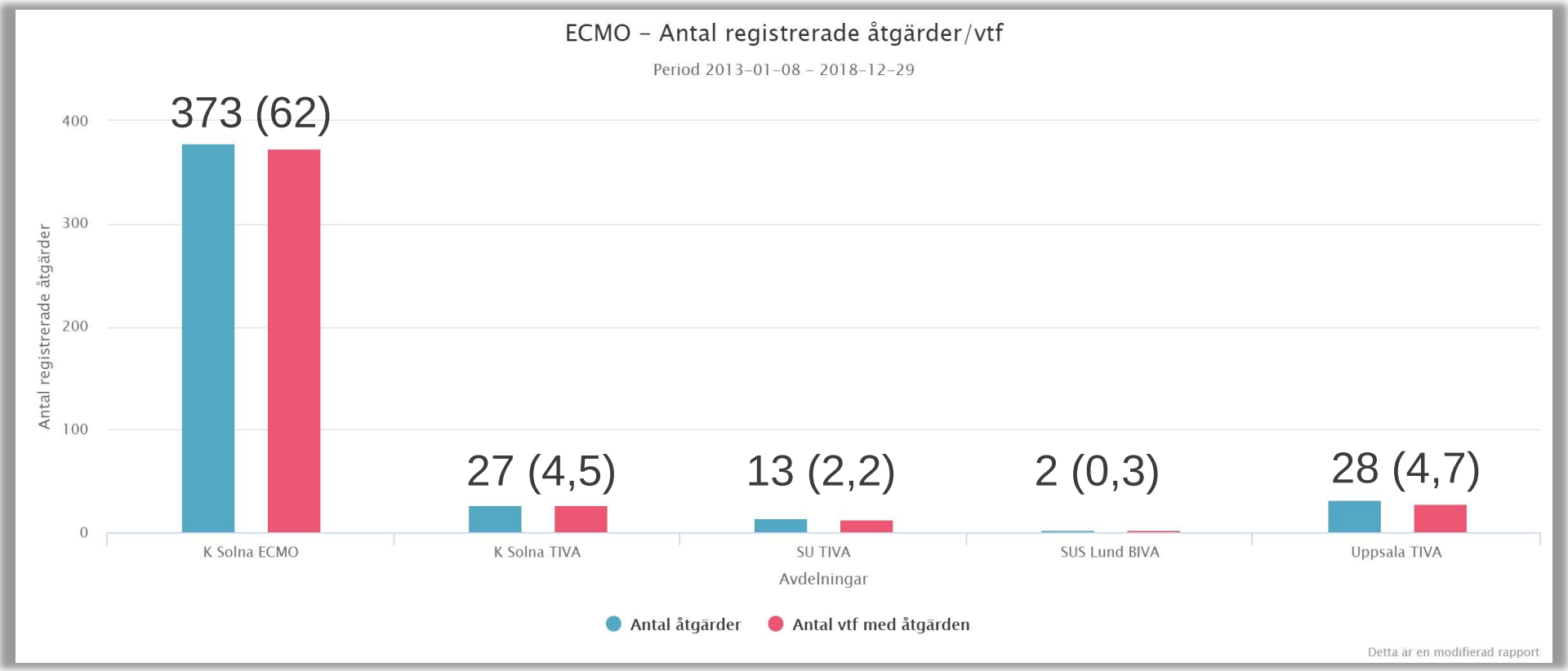
IVA-diagnos *‘Septisk chock’*



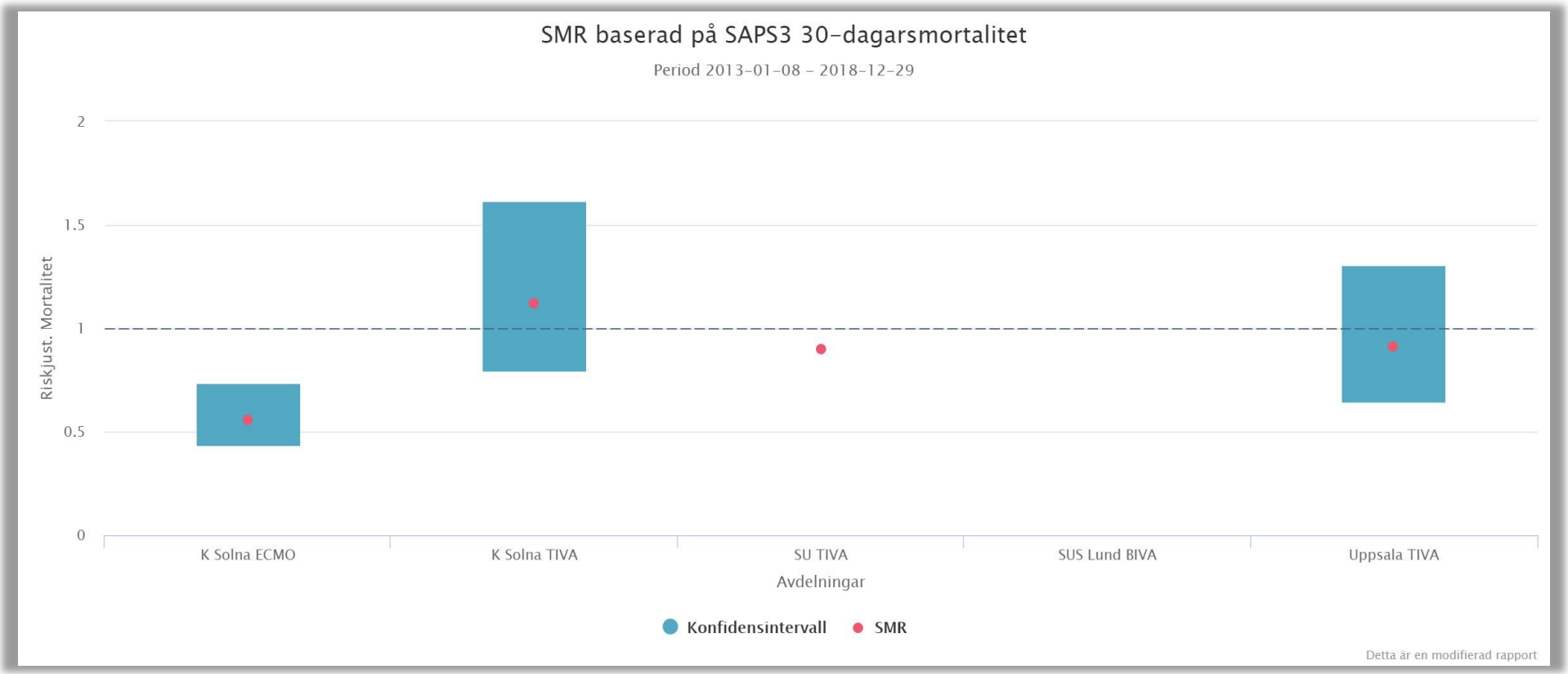
IVA-diagnos *‘Septisk chock’*



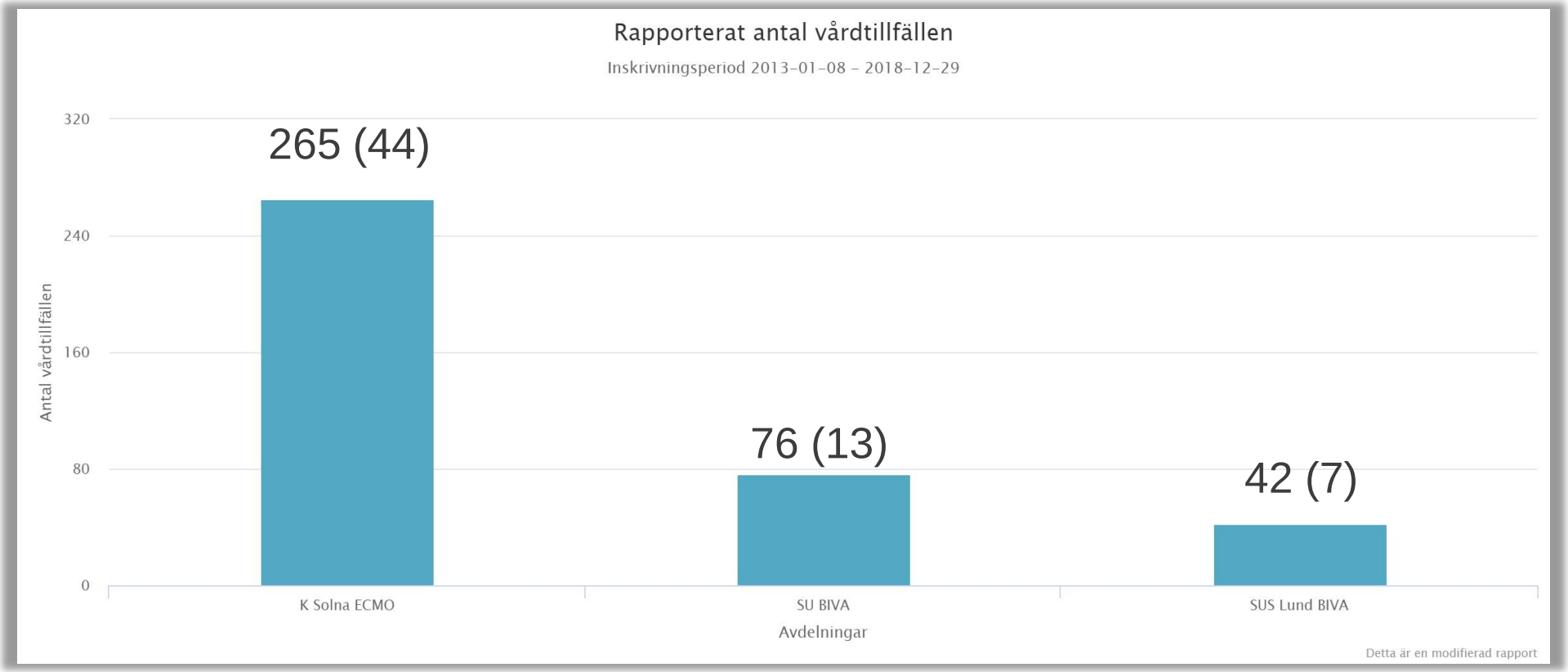
Intagningsorsak SAPS-3 *'ARDS'*



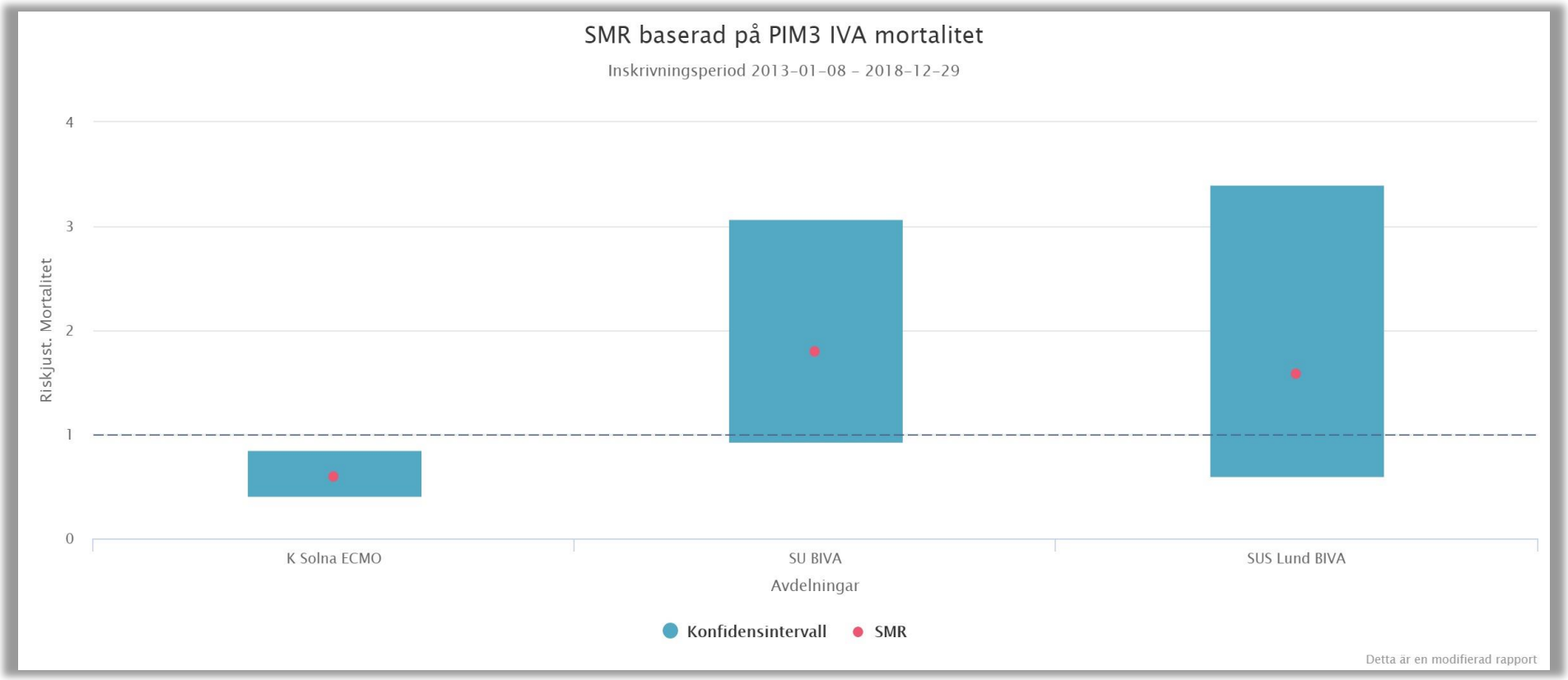
Intagningsorsak SAPS-3 *'ARDS'*



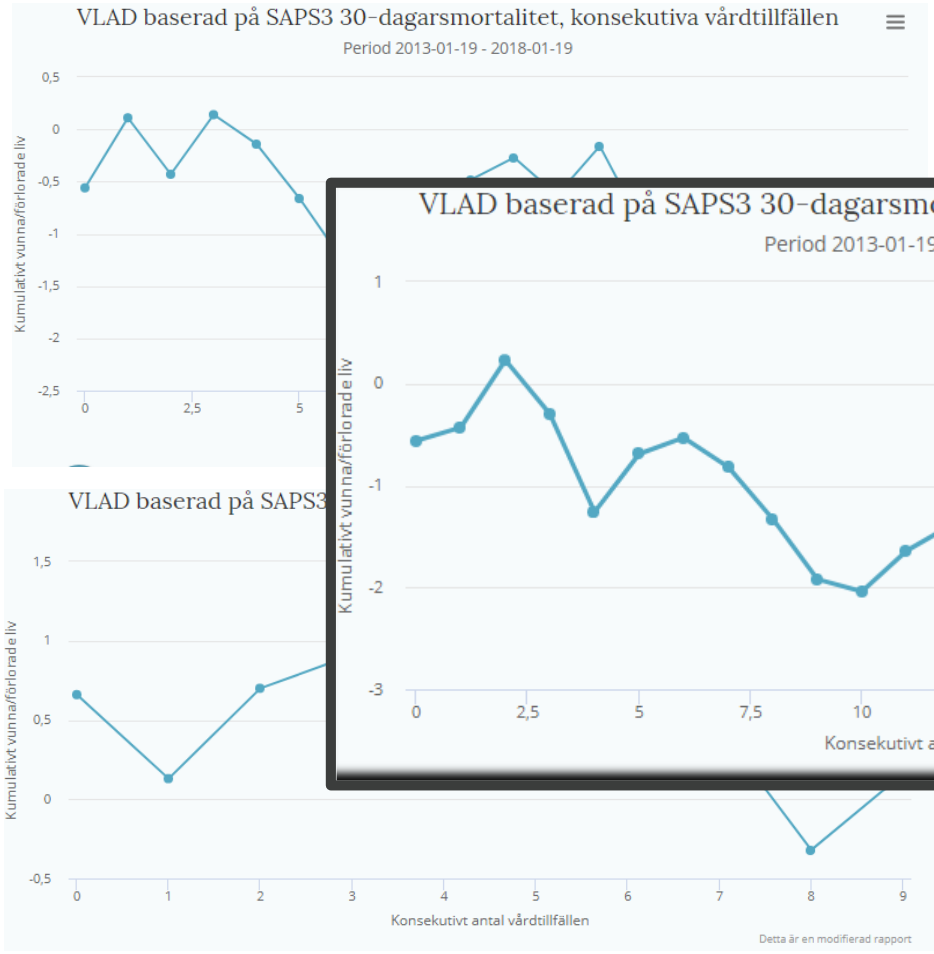
Neonatal och pediatrisk ECMO 0-18 år

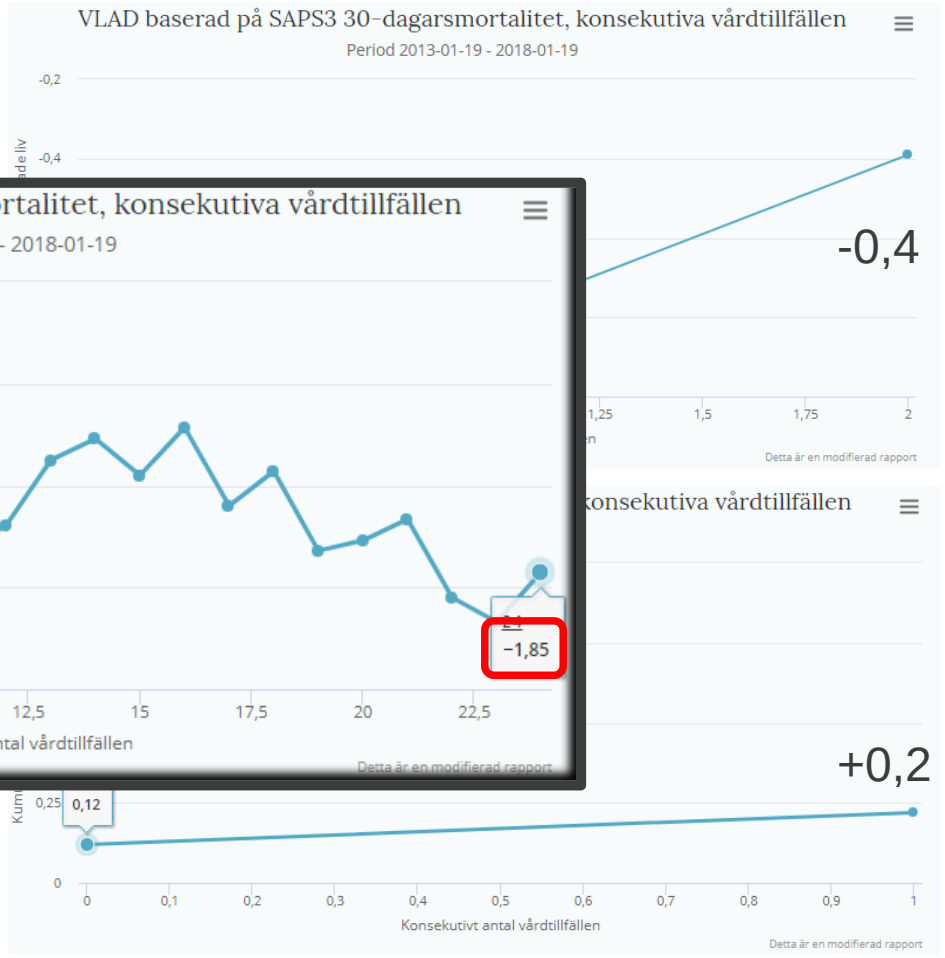


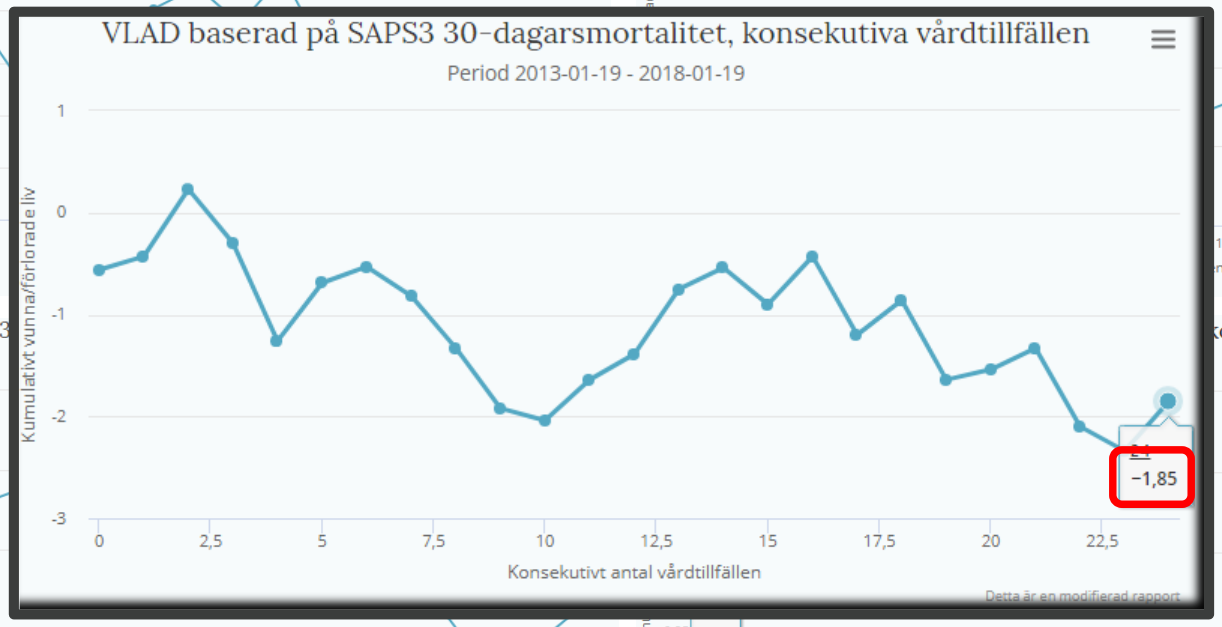
Neonatal och pediatrisk ECMO 0-18 år



Hjärtstopp (huvuddiagnos), ECPR = ECMO vid hjärtstopp







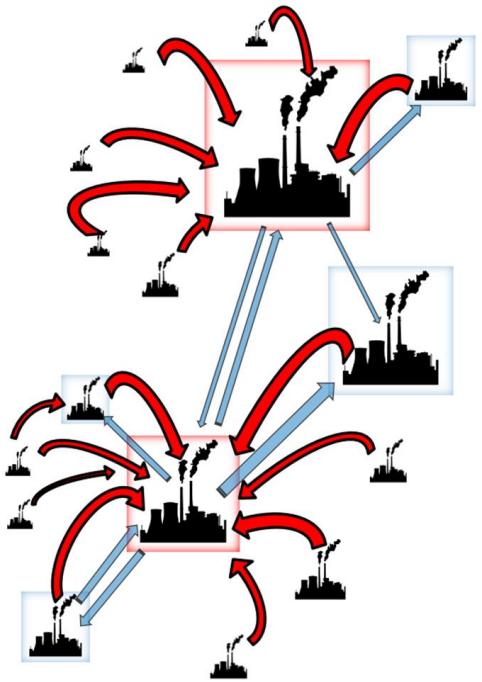
Riskjusterad mortalitet VLAD konsekutivt

Sammanfattning

Finns inget stöd i SIR eller något internnationellt register för att respiratorsik ECMO skall bedrivas på annat än högvolymcentra, >12/>30 ECMO per år; ARDS, sepsis, aspiration, etc.

“Hub-and-Spoke modellen” ger den billigaste och säkraste behandlingen för befolkning/samhälle avseende resursutnyttjande och outcome i form av lägre morbiditet och mortalitet.

Alla ECMO enheter skall vara anslutna till öppna kvalitetsregister (tex SIR), och rapporterande medlemmar till ELSO/ELSO Registry.




Bollplank, tips
Dygnet runt!
Ca 400 konsultsamtal per år
ECMO Jour
08-517 78050