GENERAL UNIVERSITY HOSPITAL IN PRAGUE

FIRST FACULTY OF MEDICINE
Charles University

LACTATE IN REFRACTORY OHCA

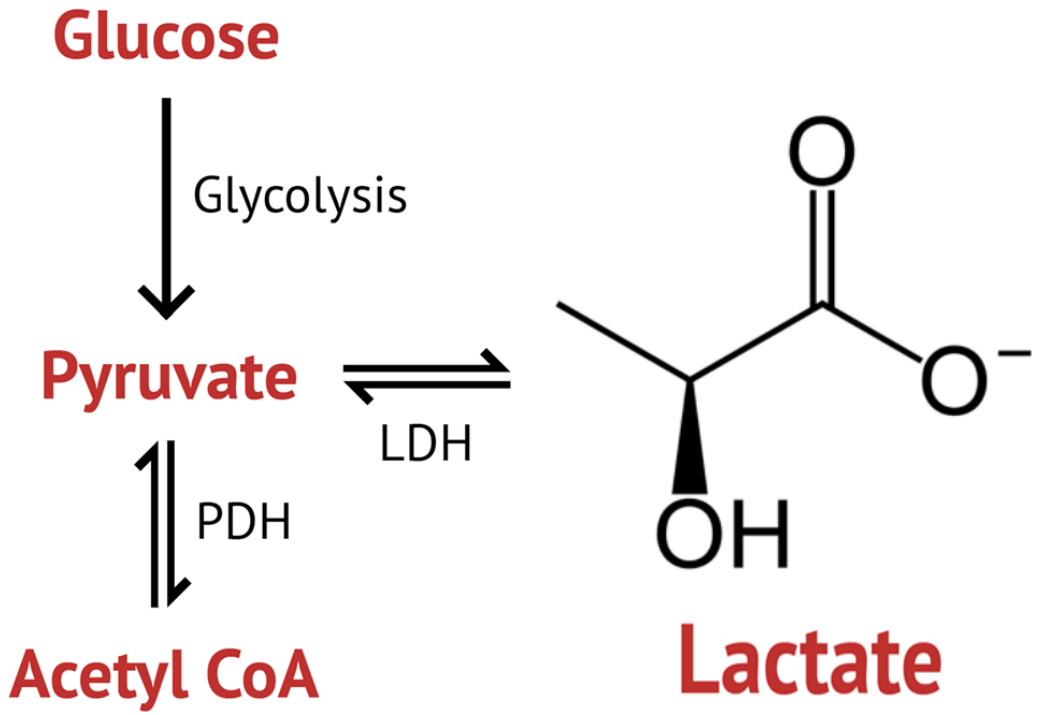
Milan Dusik

CZECH CARDIOVASCULAR RESEARCH AND INNOVATION DAYS

28th November 2022

Lactate

- Surrogate for illness severity
- Lactate elevation in CA:
  - Ischemia + reperfusion injury
  - Myocardial stunning
  - Microcirculatory dysfunction
  - Mitochondrial injury
  - Sepsis, shock gut, seizures,…
  - Adrenal insufficiency

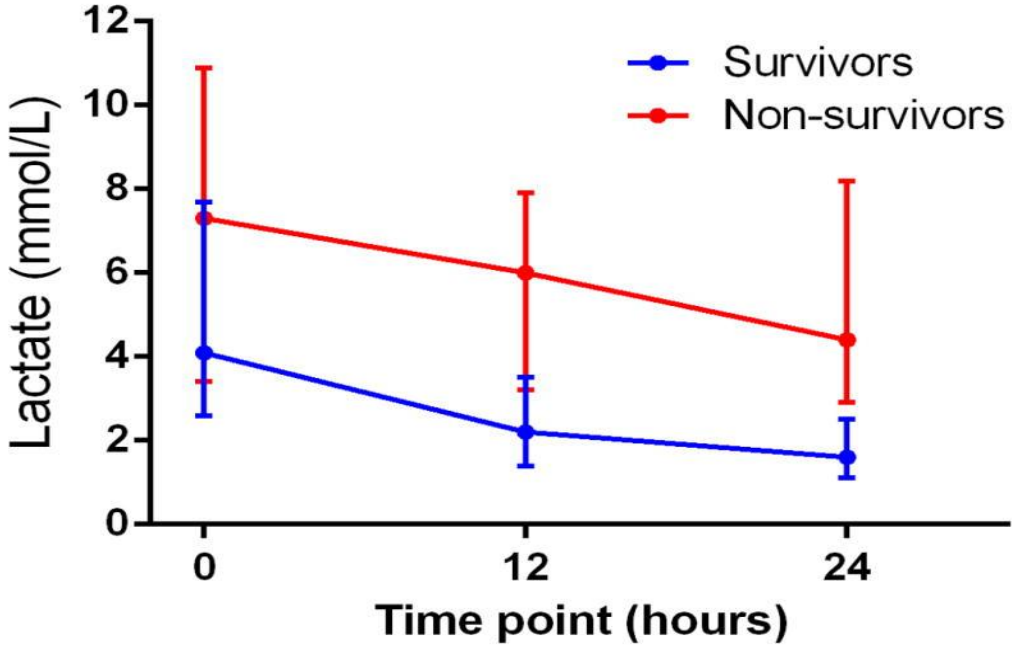


Donnino MW, Initial lactate and lactate change in post-cardiac arrest: a multicenter validation study. Crit Care Med. 2014 Aug;42(8):1804-11
https://coachendurancesports.com/lactic-acid-vs-lactate-whats-the-difference/
https://medschool.co/tests/arterial-blood-gas/lactate

Lactate and in-hospital mortality

- Adult non-traumatic OHCA patients, who were comatose after ROSC

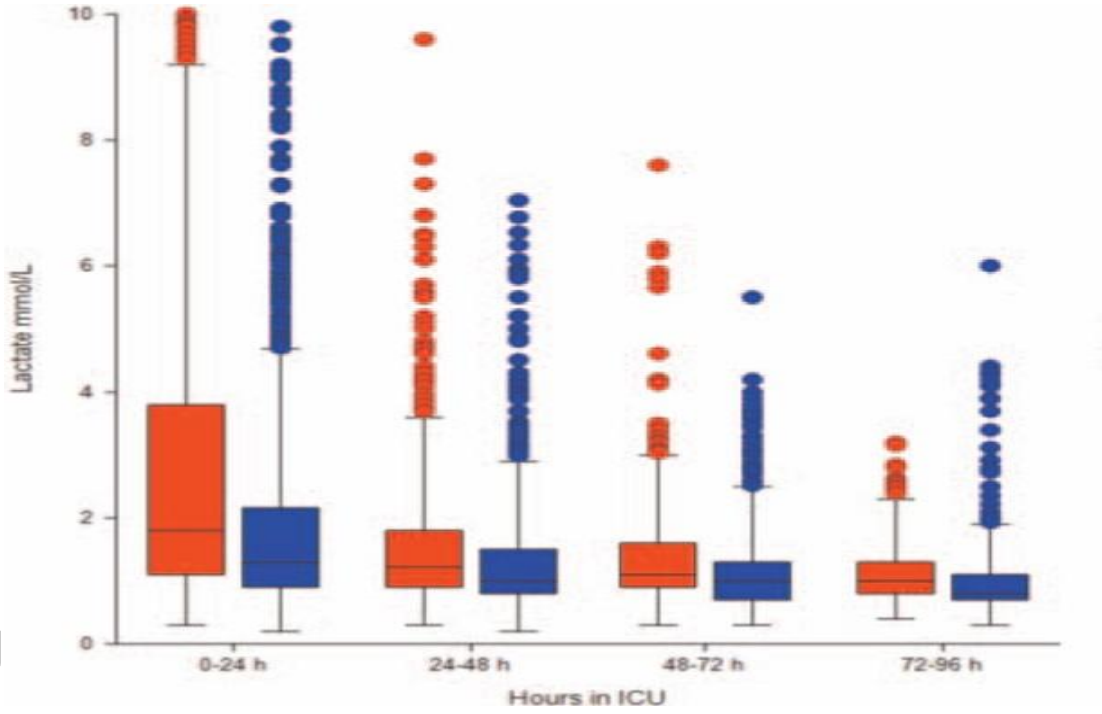
Time point	Alive	Dead	p-value	mRS 0-3	mRS 4-6	p-value
0 hour (n=100)	**4.1** (2.6 – 7.7)	**7.3** (3.4 – 10.9)	0.004	**3.9** (2.7 – 6.1)	**7.0** (3.0 – 10.4)	0.009
12 hour (n=85)	**2.2** (1.4 – 3.5)	**6.0** (3.2 – 7.9)	< 0.001	**2.2** (1.2 – 3.4)	**5.1** (2.2 – 7.0)	0.001
24 hour (n=72)	**1.6** (1.1 – 2.5)	**4.4** (2.9 – 8.2)	< 0.001	**1.5** (1.1 – 2.1)	**3.9** (1.9 – 5.8)	< 0.001



Donnino MW, Initial lactate and lactate change in post-cardiac arrest: a multicenter validation study. Crit Care Med. 2014 Aug;42(8):1804-11

Lactate and long-term outcome

- 458 OHCA patients, 1 year outcome
  - 185 (40%) patients = good
  - 273 (60%) patients = poor
- Independent predictors:
  - time-weighted **mean lactate** for the entire ICU stay
  - **last measured lactate** in the ICU



	AUC	All	Good outcome	Poor outcome	*P* value
Lactate first, mmol/L	0.64 (0.59–0.69)	4.06 (3.73–4.39)	[illegible]	[illegible]	<0.001
Lactate last, mmol/L	0.72 (0.67–0.77)	1.82 (1.58–2.05)	0.98 (0.90–1.06)	2.40 (2.03–2.78)	<0.001
Lactate min, mmol/L	0.72 (0.68–0.77)	1.37 (1.18–1.57)	0.73 (0.67–0.79)	1.83 (1.52–2.14)	<0.001
Lactate max, mmol/L	0.64 (0.60–0.70)	4.50 (4.16–4.84)	3.44 (3.05–3.83)	5.25 (4.76–5.74)	<0.001
TW mean lactate 0–24 h, mmol/L	0.61 (0.56–0.67)	2.16 (1.95–2.38)	1.65 (1.45–1.85)	2.52 (2.19–2.85)	<0.001
TW mean lactate 0–48 h, mmol/L	0.63 (0.58–0.68)	2.00 (1.80–2.20)	1.49 (1.32–1.65)	2.37 (2.05–2.68)	<0.001
TW mean lactate 0–72 h, mmol/L	0.63 (0.58–0.68)	1.94 (1.74–2.13)	[illegible]	[illegible]	<0.001
TW mean lactate in ICU, mmol/L	0.65 (0.60–0.70)	1.85 (1.65–2.04)	1.26 (1.15–1.36)	2.26 (1.95–2.57)	<0.001

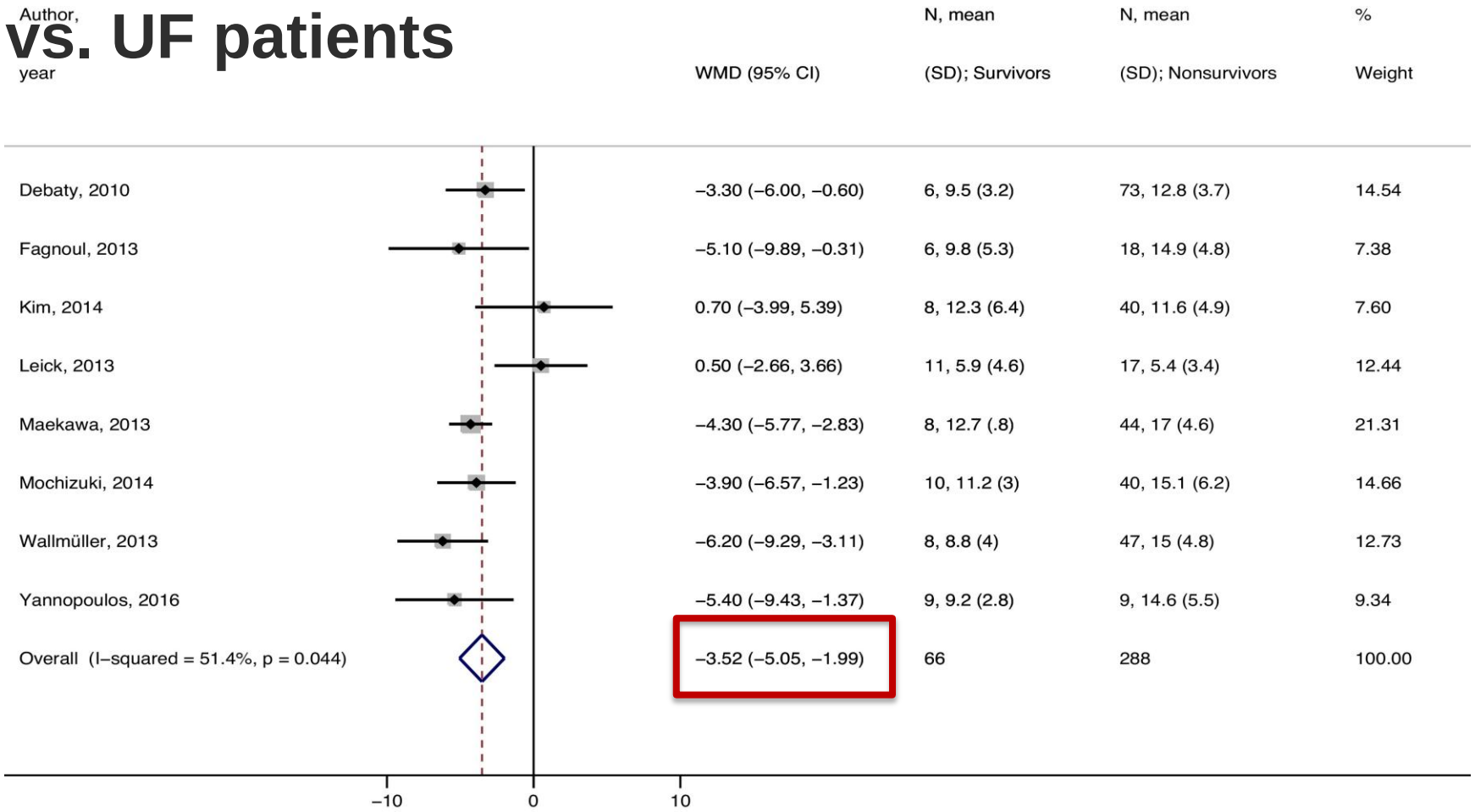
FINNRESUSCI study group: Early Lactate Values After Out-of-Hospital Cardiac Arrest: Associations With One-Year Outcome. SHOCK: February 2019 - Volume 51 - Issue 2 - p 168-173

Lactate in ECPR recipients after OHCA

Better outcome =

1. shorter low-flow duration
2. shockable cardiac rhythm
3. higher arterial pH
4. **lower serum lactate on admission**

Summary estimate for **mean difference in serum lactate** concentration on hospital admission for **F vs. UF patients**



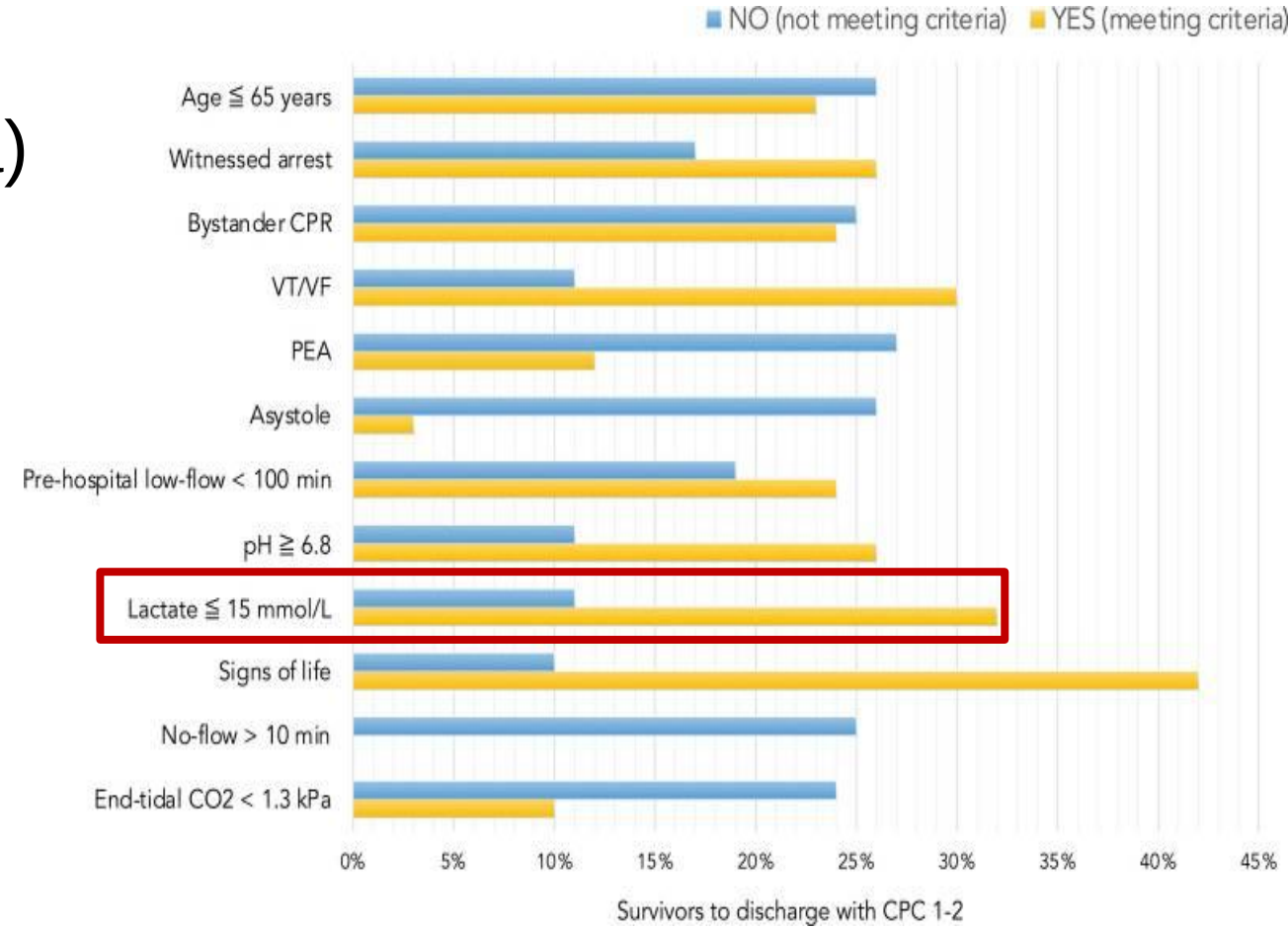
Debaty G, Prognostic factors for extracorporeal cardiopulmonary resuscitation recipients following out-of-hospital refractory cardiac arrest. A systematic review and meta-analysis. Resuscitation. 2017 Mar;112:1-10.

ECPR - Danish nationwide multicenter study

- MCS for OHCA (ECMO/Impella)

Lactate > 15 mmol/L

Increased risk of 30d mortality
(RR 1.16, 95% CI 1.16–1.53)

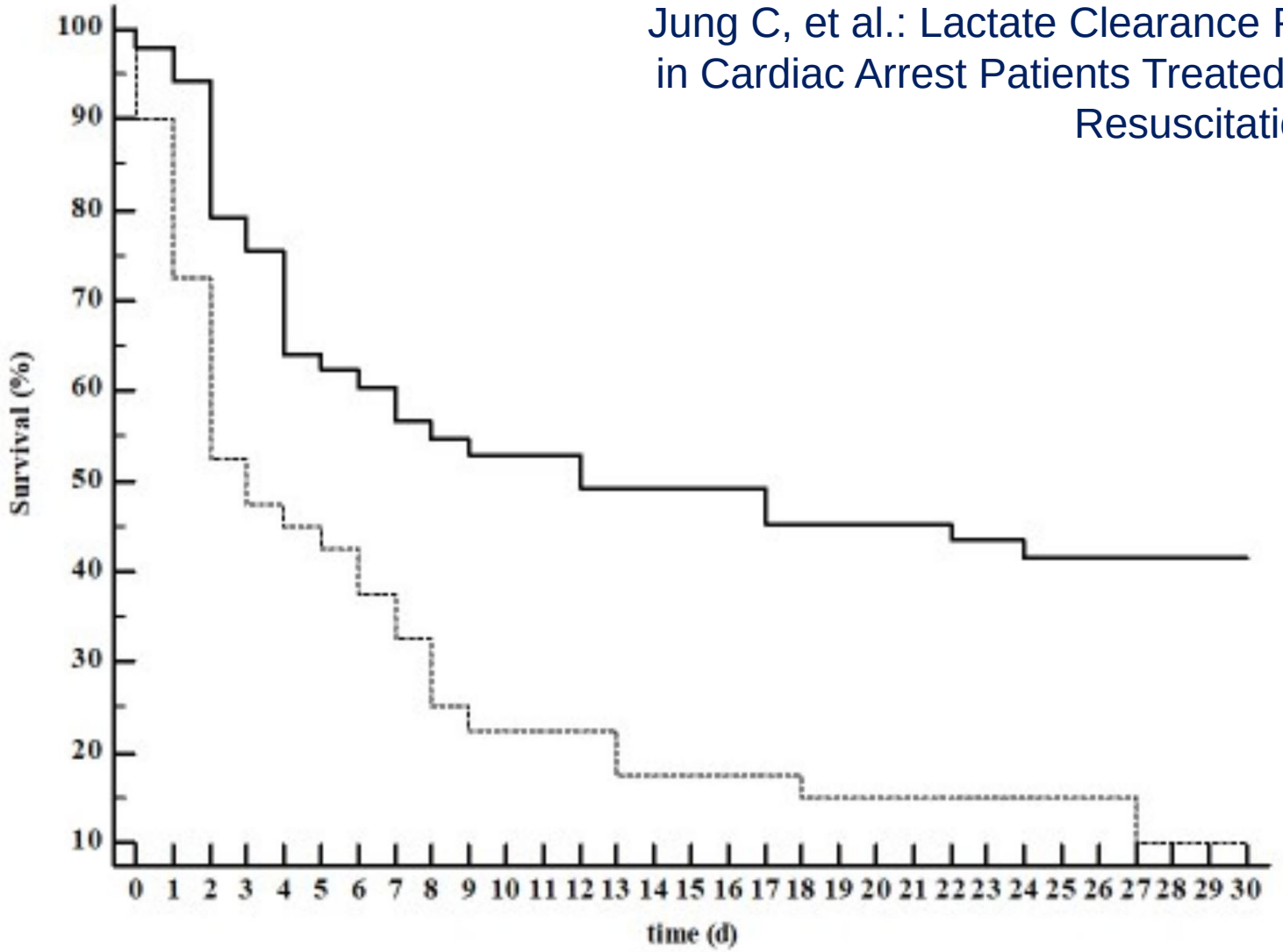


	Total (n = 259)	Survivors (n = 67)	Non-survivors (n = 192)	P-value
Lactate	14.4 [11.4–17.0]	12.0 [9.1–14.7]	15.0 [12.0–19.0]	< 0.001

Mørk SR et al.: Mechanical circulatory support for refractory out-of-hospital cardiac arrest: a Danish nationwide multicenter study. Crit Care. 2021 May 22;25(1):174

ECPR - Danish nationwide multicenter study

Jung C, et al.: Lactate Clearance Predicts Good Neurological Outcomes in Cardiac Arrest Patients Treated with Extracorporeal Cardiopulmonary Resuscitation. J Clin Med. 2019 Mar 18;8(3):374.



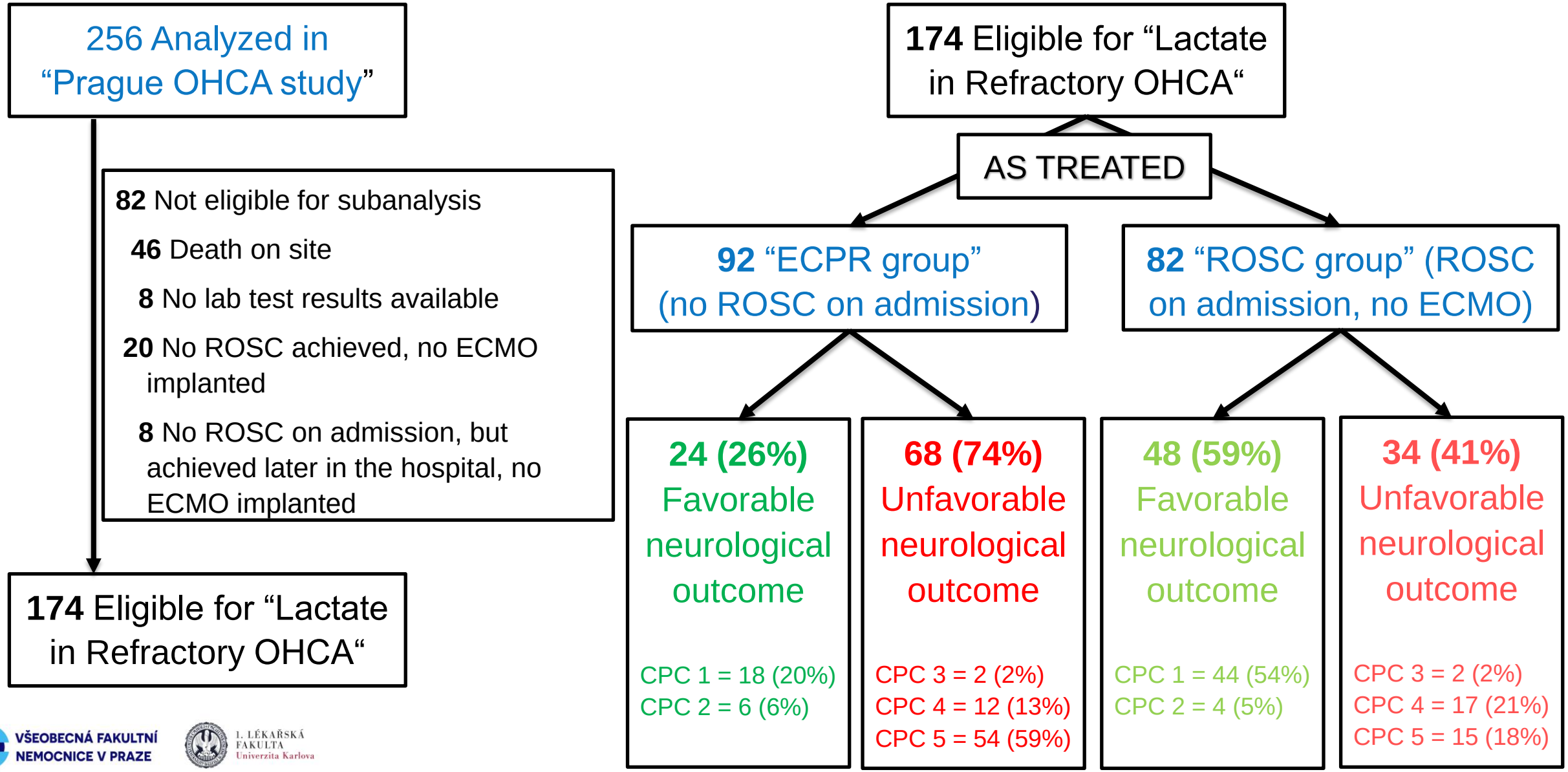
Lactate >10mmol/L
Lactate ≤10mmol/dL

Patients with lactate >10g/dL evidenced increased mortality (log-rank p<0.001)

Lactate in refractory OHCA

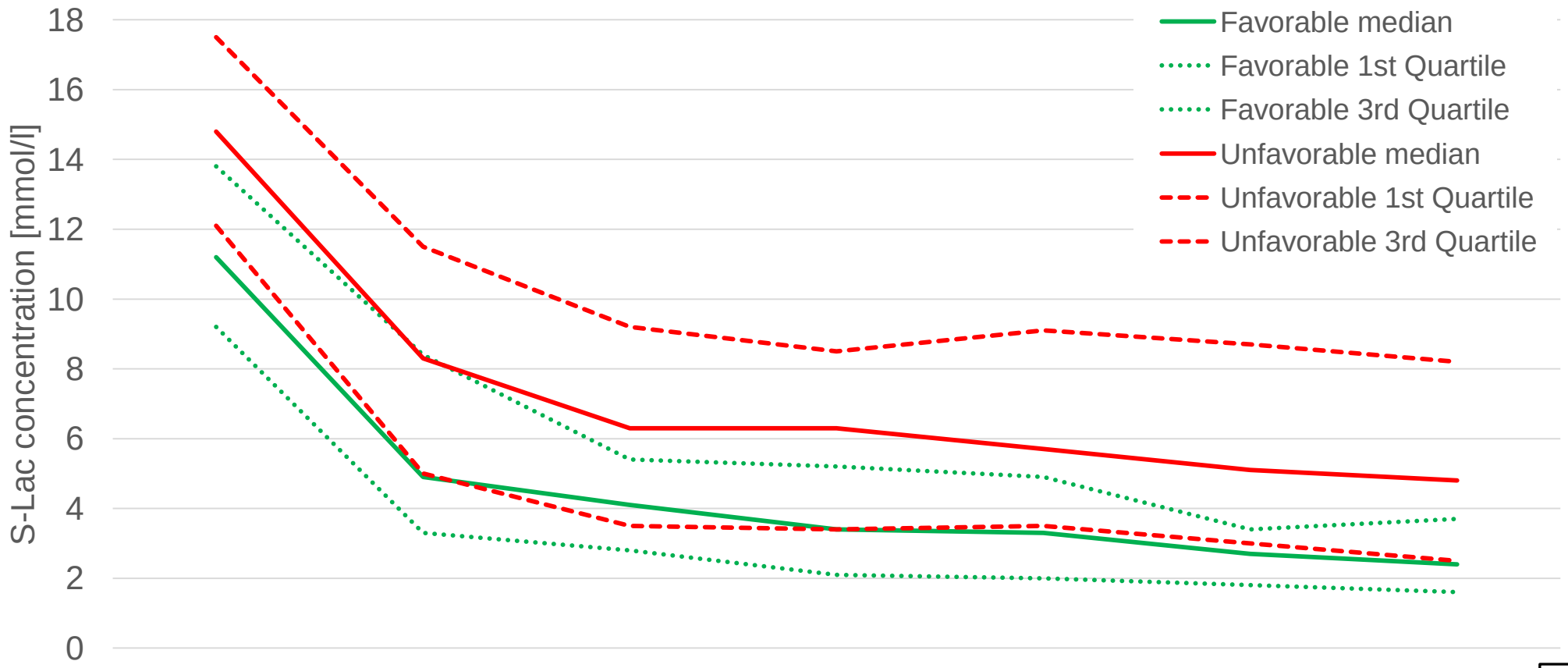
- “Prague OHCA study“ post-hoc subanalysis
- Goal: long-term **neurological outcome prediction** based on the serum **lactate levels** measured during the **first 24h** after admission
- Primary outcome: the **best CPC score** reached during the **180 days long follow-up** after the OHCA event
  - Favorable outcome = CPC 1, 2
  - Unfavorable outcome = CPC 3, 4, 5

Consort flow diagram



	ECPR group (N = 92)		ROSC group (N = 82)	
	Favorable	Unfavorable	Favorable	Unfavorable
Age, median (IQR), years	57.5 (40-64.5)	58.5 (47-65.5)	53.0 (45-61)	58.0 (51-66)
Sex				
Woman	3 (12.5)	13 (19.1)	7 (14.6)	7 (20.6)
Man	21 (87.5)	55 (80.9)	41 (85.4)	27 (79.4)
Medical history				
Hypertension	9 (37.5)	29 (50)	19 (39.6)	18 (60)
Diabetes	3 (13)	10 (17.5)	**4 (8.3)**	**10 (34.5)**
Coronary artery disease	2 (8.7)	13 (22.8)	9 (18.8)	4 (13.8)
Chronic heart failure	2 (8.7)	7 (12.1)	2 (4.2)	1 (3.4)
Initial rhythm				
VF	**23 (95.8)**	**34 (50)**	**44 (93.7)**	**17 (50)**
Asystole	**0**	**18 (26.5)**	**2 (4.2)**	**12 (35.3)**
PEA	**1 (4.2)**	**16 (23.5)**	**1 (2.1)**	**5 (14.7)**
Time from collapse to EMS arrival	**6.0 (5.3-8)**	**9 (7-11)**	9 (7-10)	9 (7.5-11.5)
Time of CPR (time to death/ROSC/ECLS)	56.5 (52-63)	61 (51-71.5)	**28 (22-36)**	**33 (25-44)**
Target temperature management used	24 (100)	66 (97.1)	**48 (100)**	**30 (88.2)**
No. of epinephrine doses prehospit.	**2.5 (1.5-5)**	**4 (3-6)**	**2 (1-4)**	**4 (3-6)**
No. of defibrillations prehospitally	6 (4-8)	5 (2-7)	4 (3-5)	3 (1.5-5)

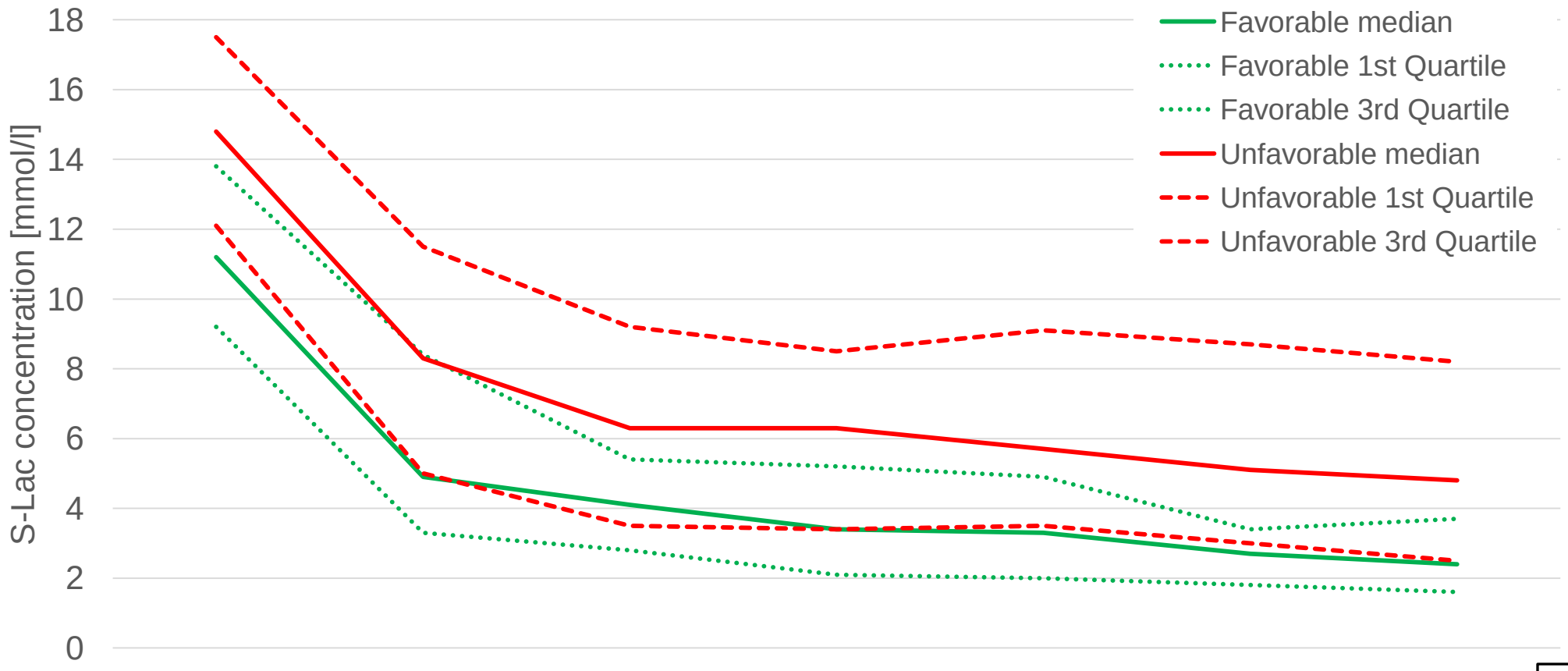
ECPR group: serum lactate concentrations



	Admission	4hrs	8hrs	12hrs	16hrs	20hrs	24hrs	**Total AUC**
Favorable	11.2 (9.2-13.8)	4.9 (3.3-8.4)	4.1 (2.8-5.4)	3.4 (2.1-5.2)	3.3 (2.0-4.9)	2.7 (1.8-3.4)	2.4 (1.6-3.7)	108 (72-146)
Unfavorable	14.8 (12.1-17.5)	8.3 (5.0-11.5)	6.3 (3.5-9.2)	6.3 (3.4-8.5)	5.7 (3.5-9.1)	5.1 (3.0-8.7)	4.8 (2.5-8.2)	154 (102-208)

Data expressed as median (IQR).

ECPR group: serum lactate concentrations



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Favorable	**11.2 (9.2-13.8)**	**4.9 (3.3-8.4)**	**4.1 (2.8-5.4)**	**3.4 (2.1-5.2)**	**3.3 (2.0-4.9)**	**2.7 (1.8-3.4)**	**2.4 (1.6-3.7)**	**108 (72-146)**
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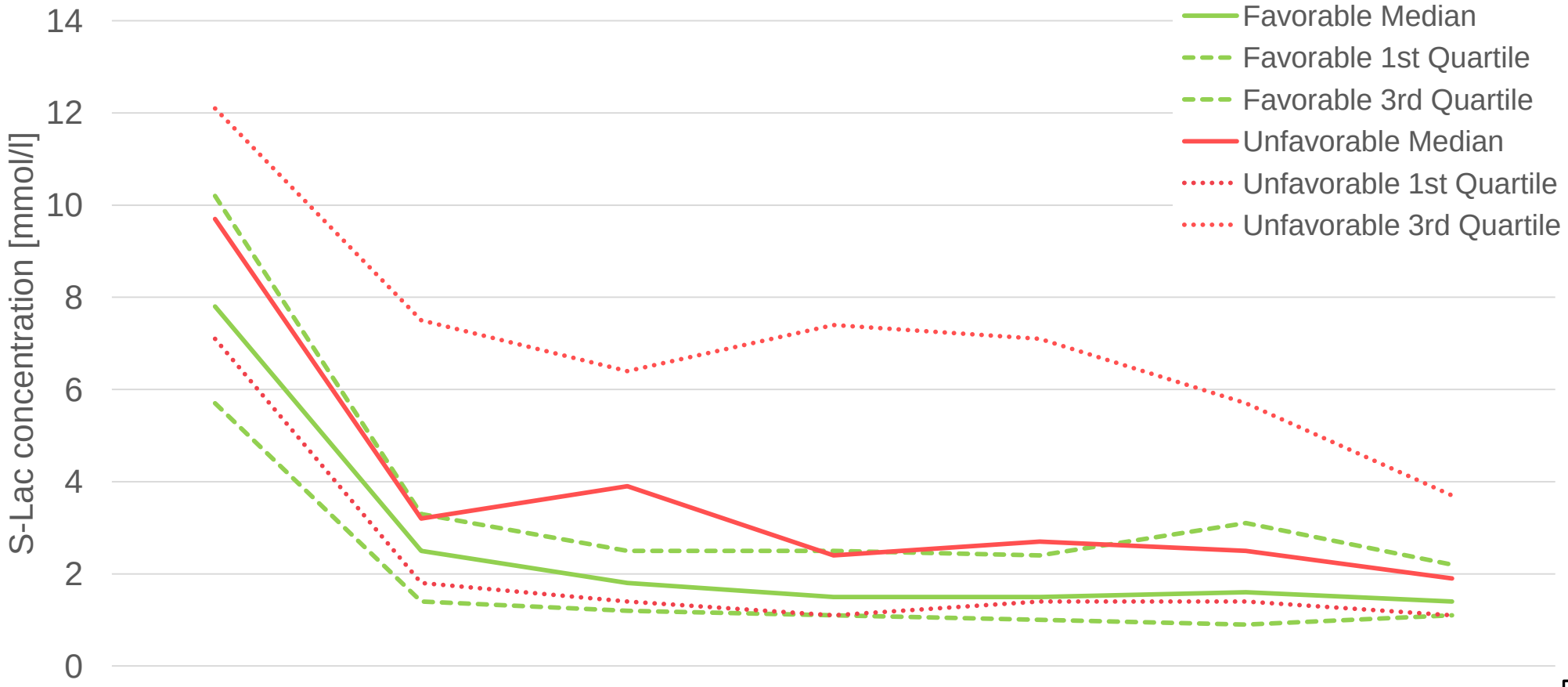
P-value	**<0,001**	**<0,01**	**0,03**	**<0,001**	**<0,01**	**<0,01**	**<0,01**	**<0,01**

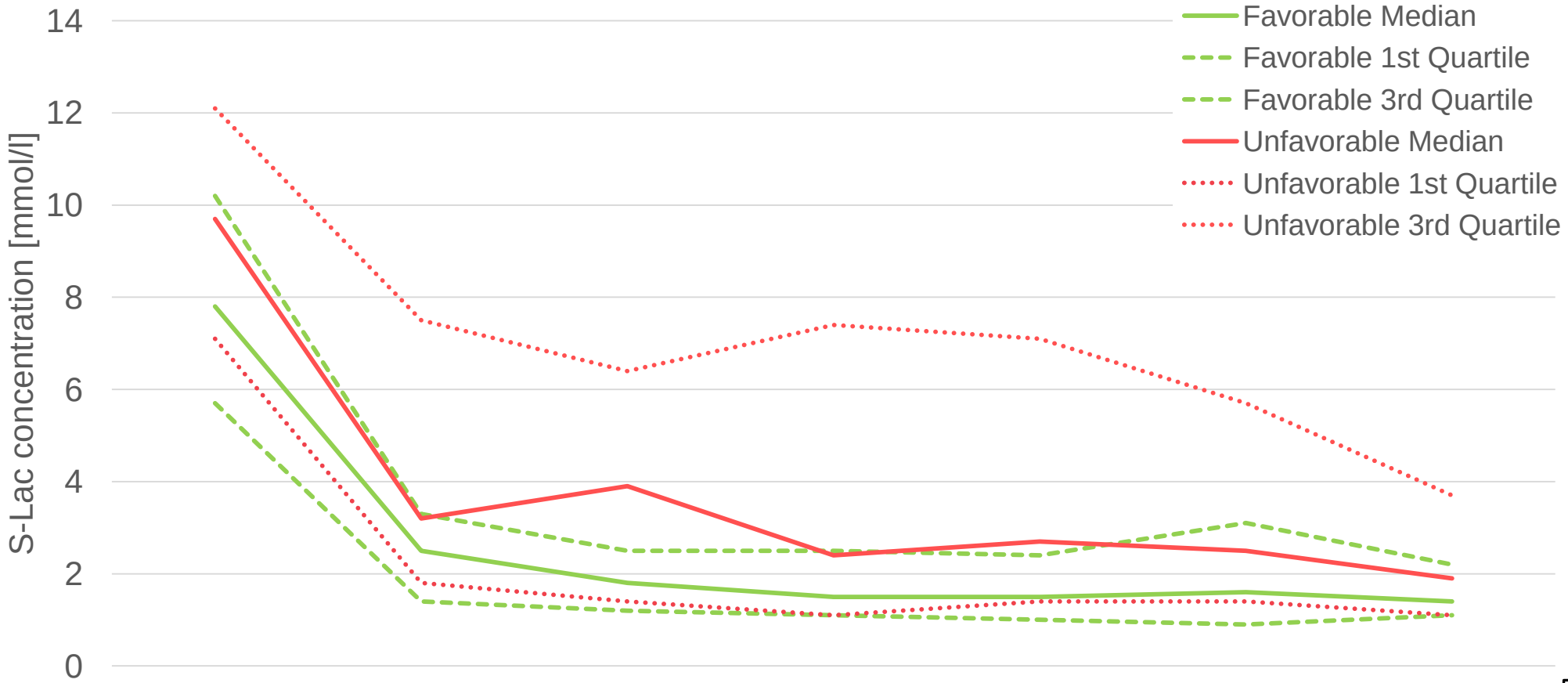
ROSC group: serum lactate concentrations



	Admission	4hrs	8hrs	12hrs	16hrs	20hrs	24hrs	**Total AUC**
Favorable	7.8 (5.7-10.2)	2.5 (1.4-3.3)	1.8 (1.2-2.5)	1.5 (1.1-2.5)	1.5 (1.0-2.4)	1.6 (0.9-3.1)	1.4 (1.1-2.2)	57 (47-75)
Unfavorable	9.7 (7.1-12.1)	3.2 (1.8-7.5)	3.9 (1.4-6.4)	2.4 (1.1-7.4)	2.7 (1.4-7.1)	2.5 (1.4-5.7)	1.9 (1.1-3.7)	68 (50-143)

Data expressed as median (IQR).

ROSC group: serum lactate concentrations



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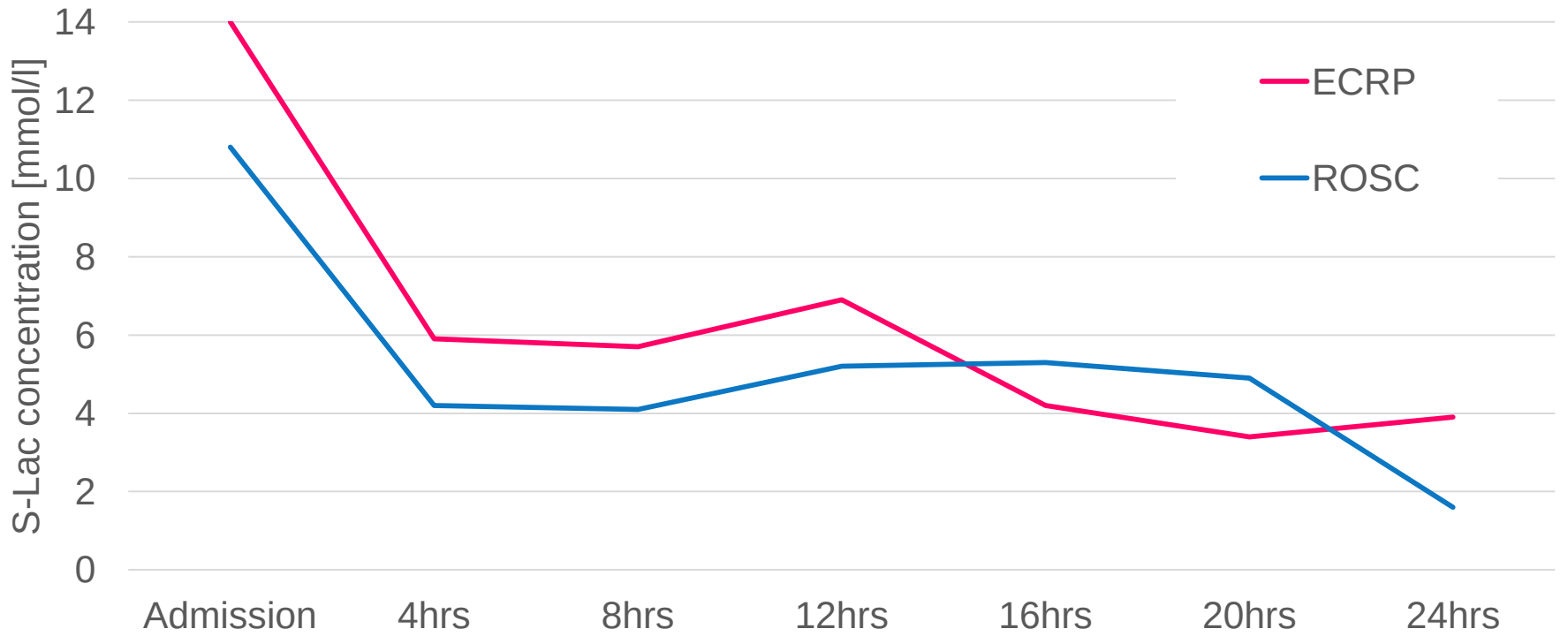
Favorable	7.8 (5.7-10.2)	**2.5 (1.4-3.3)**	**1.8 (1.2-2.5)**	**1.5 (1.1-2.5)**	**1.5 (1.0-2.4)**	1.6 (0.9-3.1)	1.4 (1.1-2.2)	**57 (47-75)**
Unfavorable	9.7 (7.1-12.1)	**3.2 (1.8-7.5)**	**3.9 (1.4-6.4)**	**2.4 (1.1-7.4)**	**2.7 (1.4-7.1)**	2.5 (1.4-5.7)	1.9 (1.1-3.7)	**68 (50-143)**
P-value	0,055	**0,017**	**0,02**	**0,04**	**0,03**	0,07	0,14	**0,04**

Cutoff values for unfavorable outcome prediction



ECPR	>14	>5.9	>5.7	>6.9	>4.2	>3.4	>3.9
Sensitivity	54.4	70.5	62.3	49.1	68.9	66.7	61.9
Specificity	87.5	70.8	84.2	95.8	72.2	78.9	81.8
ROC AUC	0.74	0.73	0.67	0.75	0.73	0.76	0.74
ROSC	**>10.8**	**>4.2**	**>4.1**	**>5.2**	**>5.3**	**>4.9**	**>1.6**
Sensitivity	41.2	48.1	50	35.7	41.2	33.3	63
Specificity	83	89.1	97.6	95.2	96.7	94.4	61.9
ROC AUC	0.63	0.67	0.67	0.64	0.69	0.64	0.61

Lactate in Refractory OHCA - conclusion

- ECPR group - UF long term neurological outcome:
  - Higher s-Lactate levels in all measurements in the first 24hrs
  - Higher total s-Lactate AUC
  - **Lactate on admission > 14.0** (specificity 88%, sensitivity 54%)
- ROSC group - UF long term neurological outcome:
  - Significantly higher s-Lactate concentrations detected only from +4hrs to +16hrs after admission
  - Higher total s-Lactate AUC
  - **Lactate on admission > 10.8** (specificity 83%, sensitivity 42%)

Thank you!

milan.dusik@vfn.cz