FAKULTNÍ NEMOCNICE® OLOMOUC

Lékařská fakulta

Univerzita Palackého v Olomouci

Organizace postresuscitační péče

Centra pro srdeční zástavu I. – organizace péče

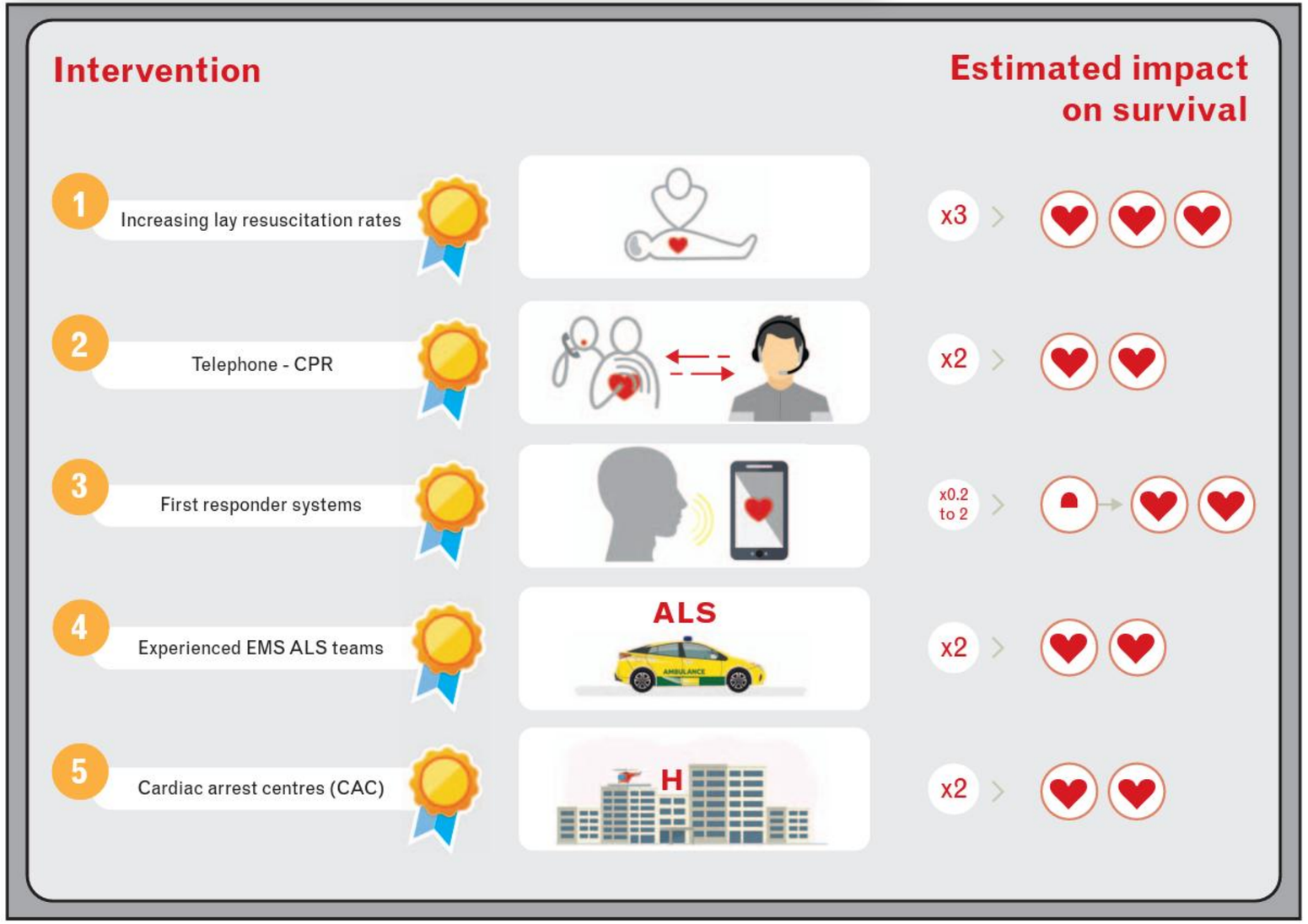
Jan Přeček

I. interní klinika – kardiologická, FN a LF UP Olomouc

20. Konference České asociace akutní kardiologie
Karlovy Vary, 5. 12. 2022

BIG FIVE strategies for survival following out-of-hospital cardiac arrest

Bernd W. Böttiger, Lance B. Becker, Karl B. Kern, Freddy Lippert, Andrew Lockey, Giuseppe Ristagno, Federico Semeraro and Sabine Wingen



Eur J Anaesthesiol 2020 Nov; 37(11): 955–958

Mimonemocniční oběhová zástava (OHCA)

- **incidence** OHCA: 19.0–104.0 / 100 000 obyvatel / rok
- **neuspokojivé přežití** s dobrým neurologickým výsledkem ≈ 10 % (EU)
- dominantní příčina OHCA u dospělých je **kardiální**
    - nekardiovaskulární příčiny (15-20 %) - trauma, krvácení, plicní embolie, závažné formy respiračních onemocnmění, intoxikace, tonutí, hypotermie...
- **komplexní, heterogenní a dynamický stav**
- nutnost **specializované péče**
- pro dosažení optimální péče je nutná adekvátní zkušenost a počet pacientů (**high-volume centers**)

OHCA – faktory ovlivňující prognózu

Panel 2: **Factors associated with survival following OHCA**

Factors that can affect survival outcomes

Patient related
- Age
- Sex
- Ethnicity
- Comorbidity
- Diet
- Obesity
- Medications
- Socioeconomic status
- Genetic determinants

Event related
- Symptoms before collapse
- Location at time of event
- Time of the day
- Witness status (bystander, EMS, no witness, or unknown)
- Decision to begin resuscitation
- Bystander CPR
- Cause of cardiac arrest
- Type of heart rhythm
- Use of on-scene AED

System related
- Time to CPR
- Quality of CPR
- Time to defibrillation
- Interaction of CPR and defibrillation
- Type of EMS system
- System size
- Number of responders
- Ratio of paramedics to population
- Dispatcher-assisted telephone CPR
- Quality of EMS care
- Ongoing medical quality improvement
- Organisational structure and culture
- Administrative support
- Quality of training
- Community CPR training
- Public access defibrillation

Therapeutic related
- Pharmacotherapy
- Impedance threshold device for CPR
- CPR adjuncts
- Compression only CPR
- Airway management
- Targeted temperature control
- Quality of in-hospital care
- Distance to invasive heart centre
- Immediate coronary angiography for all patients with OHCAs on admission to hospital

Factors shown to have a strong relationship with survival outcomes

Patient related
- Age
- Ethnicity
- Comorbidity
- Socioeconomic status

Event related
- Type of heart rhythm
- Witness status
- Bystander CPR
- Agonal breathing

System related
- Time to CPR
- Time to defibrillation
- Interaction of CPR and defibrillation
- Dispatcher-assisted telephone CPR

Therapeutic related
- No therapeutic-related factors have shown a clear association with positive outcome after OHCA

EMS=emergency medical service. CPR=cardiopulmonary resuscitation. AED=automated external defibrillator. OHCA=out-of-hospital cardiac arrest.

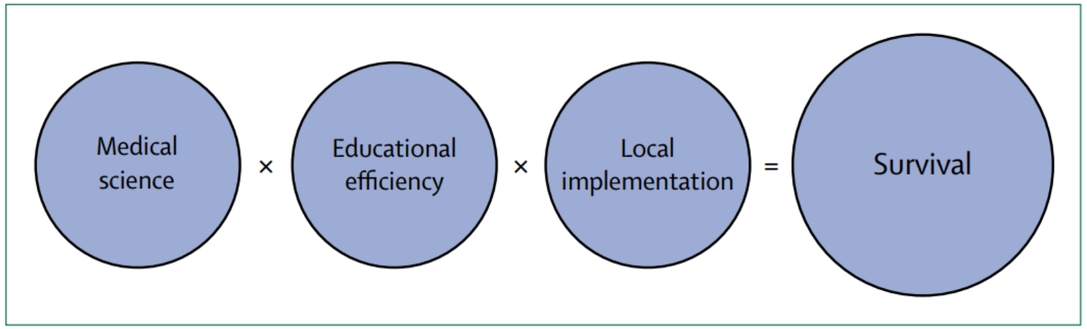


Figure 2: **The Utstein formula to improve survival after out-of-hospital cardiac arrest**

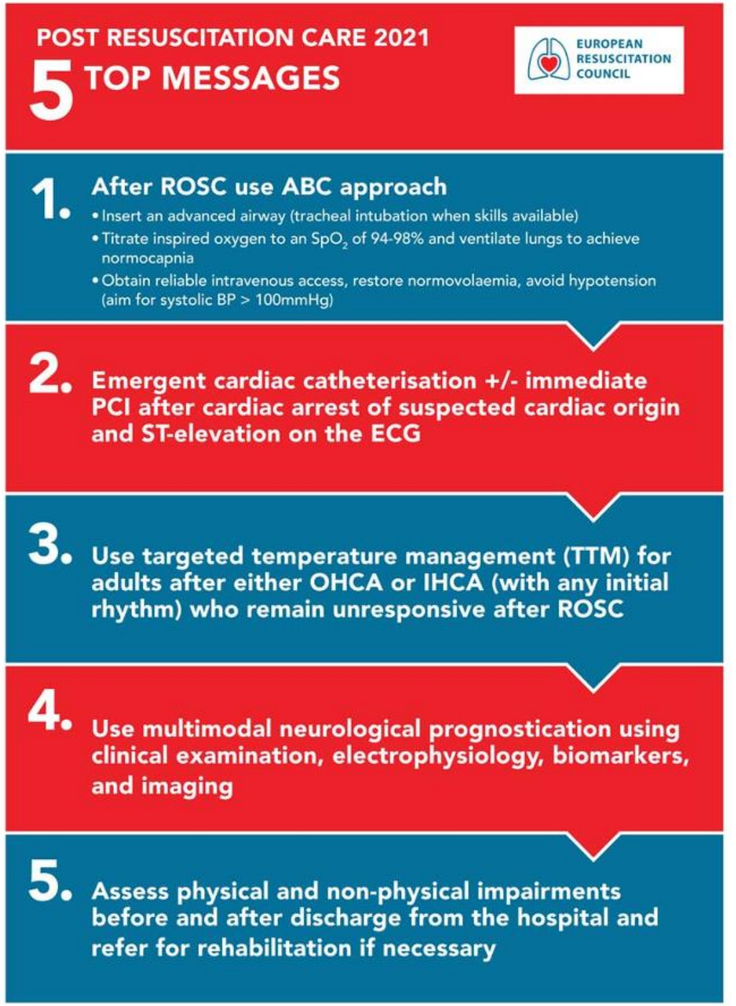
Myat A et al. Lancet 2018 Mar 10;391(10124):970-979

European Resuscitation Council and European Society of Intensive Care Medicine Guidelines 2021: Post-resuscitation care☆

Jerry P. Nolan[a,b,1,], Claudio Sandroni[c,d,1], Bernd W. Böttiger[e], Alain Cariou[f], Tobias Cronberg[g], Hans Friberg[h], Cornelia Genbrugge[i,j], Kirstie Haywood[k], Gisela Lilja[l], Véronique R.M. Moulaert[m], Nikolaos Nikolaou[n], Theresa Mariero Olasveengen[o], Markus B. Skrifvars[p], Fabio Taccone[q], Jasmeet Soar[r]*

Table 1 – Summary of changes since the 2015 Guidelines on Post-resuscitation care.

2015 Guidelines	2021 Guidelines	Rationale for change
Cardiac arrest centres		
No specific recommendation	Adult patients with non-traumatic OHCA should be considered for transport to a cardiac arrest centre according to local protocol.	An expert consensus paper published by several European organisations including the Association of Acute Cardiovascular Care (ACVA) of the European Society of Cardiology (ESC), the ERC and the ESICM, states that the minimum requirements for a cardiac arrest centre are 24/7 availability of an on-site coronary angiography laboratory, an emergency department, an ICU, imaging facilities, such as echocardiography, CT, and MRI.[16] Based on evidence from a systematic review, ILCOR suggests that wherever possible, adult patients with non-traumatic OHCA cardiac arrest should be cared for in cardiac arrest centres.[17]



EUROPEAN RESUSCITATION COUNCIL
GUIDELINES 2021

Nolan JP et al. Intensive Care Med 2021 Apr;47(4):369-421

European Heart Journal
Acute Cardiovascular Care

ESC European Society of Cardiology

Original scientific paper

European Heart Journal: Acute Cardiovascular Care
2020, Vol. 9(S4) S193–S202
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The cardiac arrest centre for the treatment of sudden cardiac arrest due to presumed cardiac cause – aims, function and structure: Position paper of the Association for Acute CardioVascular Care of the European Society of Cardiology (AVCV), European Association of Percutaneous Coronary Interventions (EAPCI), European Heart Rhythm Association (EHRA), European Resuscitation Council (ERC), European Society for Emergency Medicine (EUSEM) and European Society of Intensive Care Medicine (ESICM)

Christoph Sinning[1,2], Ingo Ahrens[2,3], Alain Cariou[4], Farzin Beygui[2,5], Lionel Lamhaut[2,6,7], Sigrun Halvorsen[2,8], Nikolaos Nikolaou[9,10], Jerry P Nolan[10–12], Susanna Price[2,13], Koenraad Monsieurs[14], Wilhelm Behringer[15,16], Maurizio Cecconi[17–19], Eric Van Belle[20], Xavier Jouven[21] and Christian Hassager[22]

Eur Heart J Acute Cardiovasc Care 2020 Nov;9(4_suppl):S193-S202

Table 1. The definition and rationale for the cardiac arrest centre (CAC).

Consensus	Evidence type	References
The CAC is the treatment facility for all patients with OHCA of presumed cardiac cause.	**O**	7,12,13,16
Effective therapies for OHCA are often used insufficiently in daily practice because of a lack of resources, staff, infrastructure, experience and knowledge in the responsible medical systems.	**O, E**	14
The CAC needs to be embedded into a network with close cooperation with the emergency medical services.	**E**	7,23
The regionalisation of OHCA patients in the CAC is an approach that has been described as reasonable if local facilities are unable to deliver comprehensive post-cardiac arrest care.	**E**	11
The number of OHCA cases varies significantly between countries, and the observed differences in incidence reflect differences in the underlying risk of OHCA.	**O**	18,24
High-performing centres demonstrate faster times to treatment and are more compliant with guideline-recommended therapy.	**O**	15
Treating at least 40 patients/year whenever possible has been associated with an improved outcome, as has the presence of an on-site coronary angiography laboratory.	**O**	19–22,25

OHCA: out-of-hospital cardiac arrest.
O refers to observational and E to expert opinions.

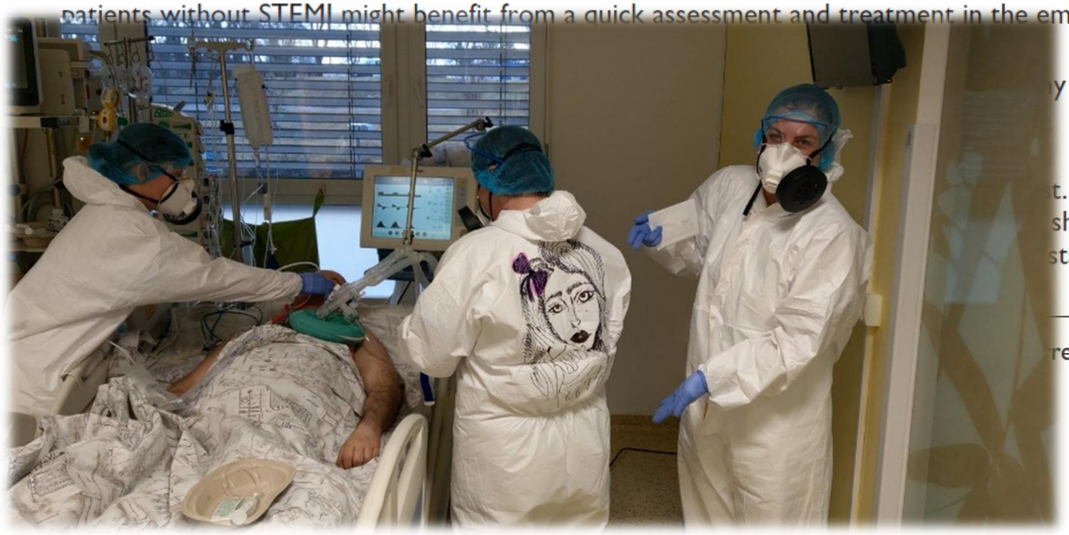
Sinning Ch et al. Eur Heart J Acute Cardiovasc Care 2020 Nov;9(4_suppl):S193-S202

Funkce CAC

Table 2. Functions of the cardiac arrest centre (CAC).

Consensus	Evidence type	References
Prehospital treatment		
Bystander CPR is one of the key factors in patient survival; its prevalence varies substantially. The CAC should promote bystander CPR whenever possible by teaching and education of various individuals and professionals.	**O**	5,18
Target improving the frequency of high-quality bystander CPR and extensive implementation of public access defibrillation.	**O**	2,23,27
In-hospital/acute coronary syndrome/emergency department		
The CAC should have access to a coronary angiography laboratory capable of performing PCI (24/7) without delay.	**O; E**	8,16,20–23,31
Conscious and comatose survivors of OHCA with ECG criteria for STEMI on the post-resuscitation ECG should be admitted directly to the catheterisation laboratory. Haemodynamically unstable patients without STEMI might benefit from a quick assessment and treatment in the emergency	**O, E**	17,30
y should be	**O, E**	3,17,22
t.	**O, E**	7
shockable as stant target	**R, O, E**	3,7,36

rest; PCI: percutaneous coronary intervention;

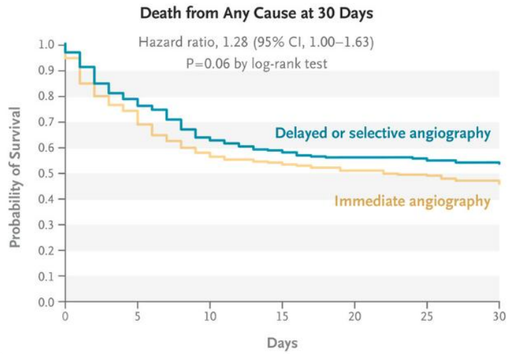


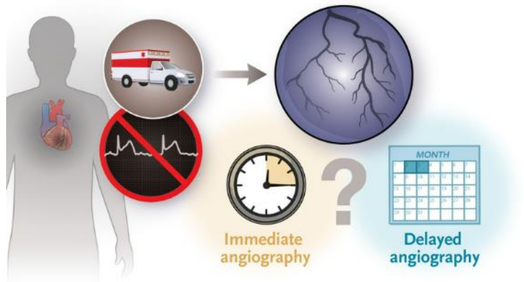
Sinning Ch et al. Eur Heart J Acute Cardiovasc Care 2020 Nov;9(4_suppl):S193-S202...

Koronární angiografie

Angiography after Out-of-Hospital Cardiac Arrest without ST-Segment Elevation

Desch S et al. DOI: 10.1056/NEJMoa2101909





Inclusion criteria

- Documented resuscitated OHCA of possible cardiac origin and return of spontaneous circulation
- Age ≥30 years
- Informed consent

Exclusion criteria

- ST-segment elevation or left bundle branch block
- No return of spontaneous circulation upon hospital admission
- Severe hemodynamic or electrical instability requiring immediate coronary angiography/intervention (delay clinically not acceptable)
  - Life-threatening arrhythmia possibly caused by acute myocardial ischemia
  - Cardiogenic shock (defined by clinical and hemodynamic criteria)
- Obvious extra-cardiac etiology such as traumatic brain injury, primary metabolic or electrolyte disorders, intoxication, overt hemorrhage, respiratory failure due to known lung disease, suffocation, drowning
- In-hospital cardiac arrest
- Known or likely pregnancy
- Participation in another intervention study interfering with the research questions of the TOMAHAWK trial

Inclusion criteria COACT Trial

- Age > 18 years
- Comatose patients (Glasgow coma score < 8) with return of spontaneous circulation after out-of-hospital cardiac arrest.
- Ventricular tachycardia or ventricular fibrillation as initial arrest rhythm. Including patients treated with an AED.

Abbreviations: AED: automatic external defibrillator.

Exclusion criteria COACT Trial

- Signs of STEMI on the ECG at the emergency department (including new LBBB or isolated ST depression in V1-V3 due to an true posterior infarct).
- Hemodynamic instability unresponsive to medical therapy. Defined as a prolonged (>30 min) systolic blood pressure <90 mmHg at the time of screening.
- An obvious or suspected non-coronary cause of the arrest.
- A known severe renal dysfunction (GFR<30 ml/min).
- Obvious or suspected pregnancy.
- Suspected or confirmed acute intracranial bleeding.
- Suspected or confirmed acute stroke.
- Known limitations in therapy or DO Not Resuscitate-order.
- Known pre-arrest Cerebral Performance Category 3 or 4.
- >4 hours (from return of spontaneous circulation to screening).
- Refractory ventricular arrhythmia.
- Known inability to complete 90-day follow-up.

CAC – OHCA hub

CAC (Cardiac Arrest Centre)

Emergency department for assessment of patient without STEMI criteria for non-cardiac causes
Coronary angiography 24/7
ICU with the option of TTM
Imaging facilities (TTE, TEE, CT and MRI)
Rehabilitation service
Education and teaching
Data acquisition and quality control

OHCA hub hospital

All features of the CAC AND
Mechanical assist device program – eCPR
Arrhythmia management with EPS
Device management
Research facilities and fund raising

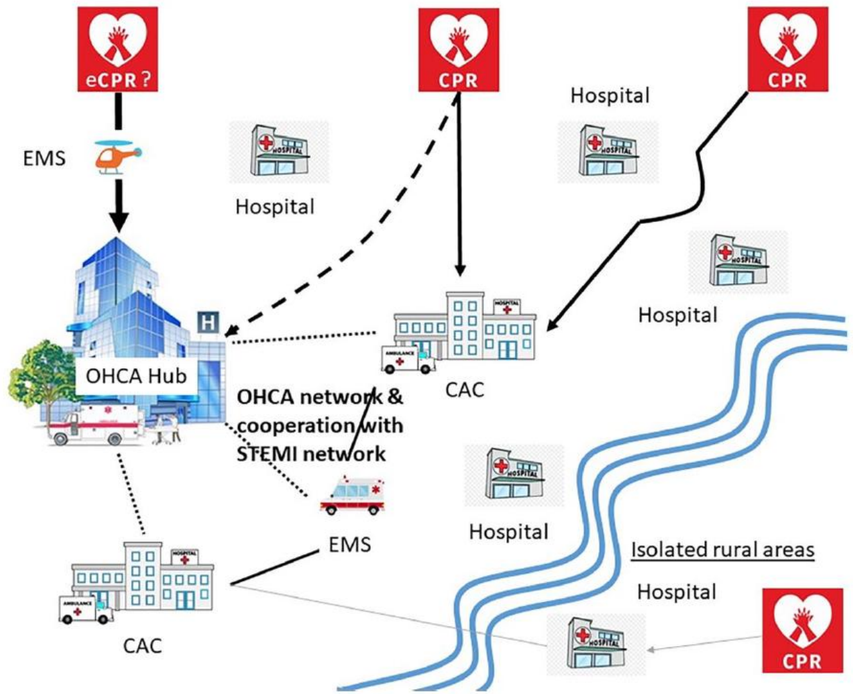


Table 3. Recommended structure of the out-of-hospital cardiac arrest (OHCA) network.

Consensus	Evidence type	References
In the acute phase, the OHCA patient should be transported to a CAC.	O, E	11
Hospitals not representing a CAC may be bypassed for the treatment of OHCA patients.	O, E	23
All CACs are recommended to collaborate closely with an OHCA hub hospital as a high-volume centre.	E	11
Because of the vast diversity in infrastructure and hospitals in Europe, recommendations regarding patient management may not be universally feasible.	E	

CAC: cardiac arrest centre.
O refers to observational and E to expert opinions.

Cardiac Arrest Centre (CAC)	OHCA hub hospital
Patients with pre-OHCA chest pain - ECG criteria of ischemia and ST-segment elevation as assessed by the emergency medical service [30] - If no criteria of ongoing infarction, assessment of non-cardiac causes in the emergency department [2, 7, 30]	**If available, all OHCA patients should be preferentially transferred to the OHCA-hub hospital** - Applies if there is an OHCA hub hospital in the local OHCA network
Ventricular fibrillation/tachycardia as initial rhythm - Both rhythm disorders are closely related to CAD [30, 42]	**Young patients aged below <35 years[42] and OHCA** - Additional diagnostic needed regarding genetic testing [42] - Evaluation if candidate for eCPR [41]
Sudden collapse and known CAD - Likelihood of progression or event of the underlying cardiac disease [17, 30, 42]	**Patients with hemodynamic criteria of cardiogenic shock** - Evaluation of mechanical cardiac assist device [32]
ECG criteria matching STEMI criteria as first rhythm - Recommendation for immediate coronary angiography [29]	**Patients without ROSC potentially eligible for eCPR** - Strict criteria for eCPR followed by coronary angiography [41]
ECG criteria consistent with non-ST elevation myocardial infarction and haemodynamically unstable patient - Likelihood of cardiac ischemia - Potential additional option of mechanical cardiac assist device in cardiogenic shock[17, 29, 30]	**Incessant ventricular tachycardia/ fibrillation** - Treatment of incessant VT in a dedicated institution with competence in rhythm management [42]

Sinning Ch et al. Eur Heart J Acute Cardiovasc Care 2020 Nov;9(4_suppl):S193-S202

Centra po srdeční zástavě

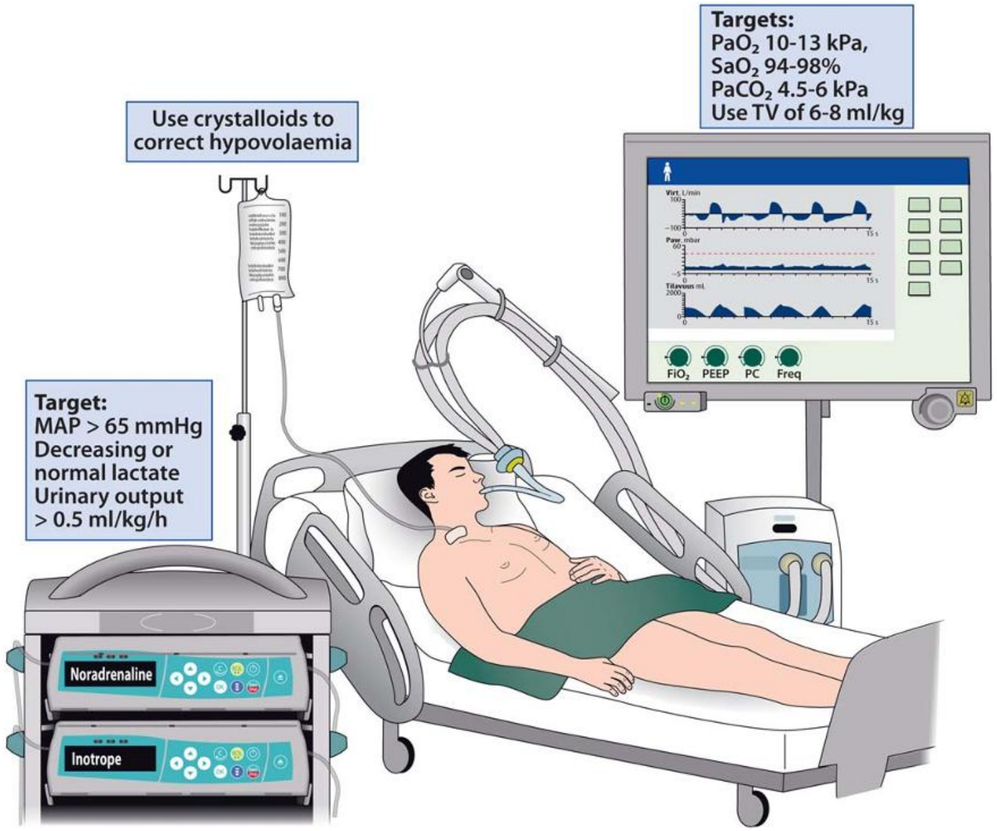


Fig. 3 – Haemodynamic, oxygenation and ventilation targets.

- **Návaznost na další pracoviště mimo kardiocentrum**
  - nekardiální příčiny oběhové zástavy
  - řešení komplikací v průběhu poresuscitační péče
- Neurologie
- Neurochirurgie
- Intervenční radiologie
- Intenzivní medicína
- Traumacentrum
- Transplantační centrum
- Paliativní tým
- Následná intenzivní péče
- ….

Odborné stanovisko | Expert consensus statement

Centra péče o nemocné po srdeční zástavě.

Společné stanovisko odborných společností:
České asociace akutní kardiologie České kardiologické společnosti, České resuscitační rady, České společnosti intenzivní medicíny ČLS JEP, České společnosti anesteziologie, resuscitace a intenzivní medicíny ČLS JEP, Společnosti urgentní medicíny a medicíny katastrof ČLS JEP

(Cardiac Arrest Centers. Joint Statement of Czech Professional Societies:
Czech Acute Cardiac Care Association of the Czech Society of Cardiology, Czech Resuscitation Council, Czech Society of Intensive Care Medicine ČLS JEP, Czech Society of Anesthesiology, Resuscitation and Intensive Care Medicine ČLS JEP, and Society for Emergency and Disaster Medicine ČLS JEP)

Petr Ošťádal[a,f], Richard Rokyta[a,g], Martin Balík[c,d,h], Jan Bělohlávek[a,i], Karel Cvachovec[c,d,j], Vladimír Černý[c,d,k], Pavel Dostál[c,d,l], Tomáš Janota[a,b,m], Petr Kala[a,n], Martin Matějovič[c,o], Jiří Pařenica[a,n], Jana Šeblová[e,p], Roman Škulec[b,q], Vladimír Šrámek[c,r], Anatolij Truhlář[b,s]

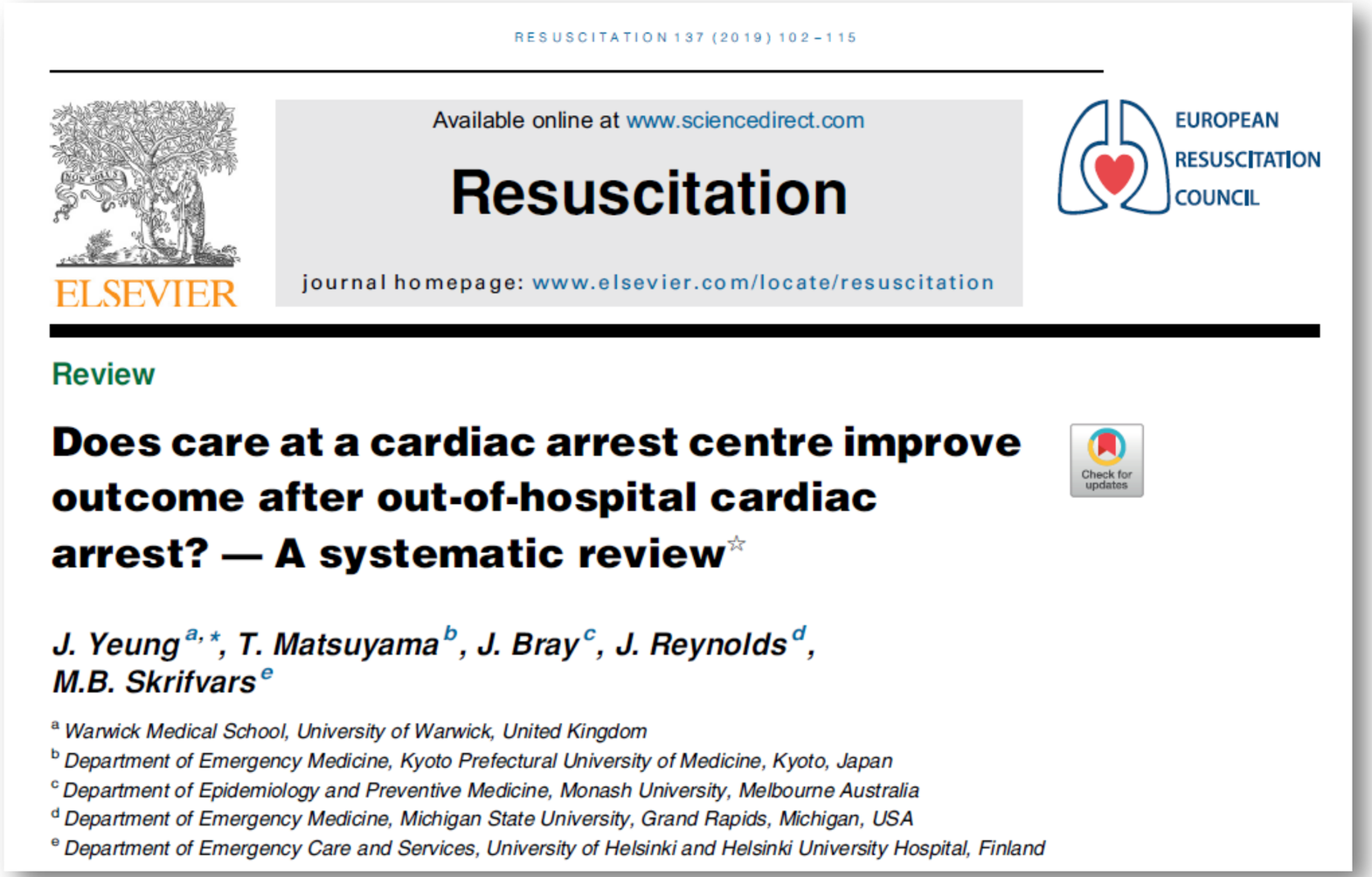
Definice Centra péče o nemocné po srdeční zástavě

Příslušné centrum musí disponovat dostatečnou kapacitou lůžek resuscitační péče pro příjem nemocných po srdeční zástavě a kvalifikovaným lékařským i nelékařským zdravotnickým personálem vyškoleným v diagnostických, rozhodovacích a léčebných postupech u těchto nemocných. Nepřetržitě, tzn. 24 hodin, sedm dnů v týdnu, musí být zajištěna dostupnost a proveditelnost následujících postupů:

- diagnostika nezbytnými zobrazovacími metodami (především echokardiografie/ultrazvukové vyšetření a CT),
- koronární angiografie a perkutánní koronární intervence,
- dočasná kardiostimulace,
- perikardiocentéza,
- cílená regulace tělesné teploty na úrovni 33 °C nebo 36 °C,
- komplexní resuscitační a poresuscitační péče,
- zajištění mimotělní KPR (ECPR) může být výhodou, ale není povinné vzhledem k nízké úrovni současné evidence.

V závislosti na příčině náhlé zástavy oběhu, dalších zjištěných nálezech u každého individuálního nemocného a aktuální dostupnosti může být příslušné resuscitační lůžko součástí kardiologických jednotek intenzivní péče (KJIP), anesteziologicko-resuscitačních oddělení, eventuálně jiných oborových, popřípadě multioborových jednotek intenzivní péče.

*Ošťádal P et al. Cor et Vasa 59 (**2017**) e196–e199*



RESUSCITATION 137 (2019) 102–115

Available online at www.sciencedirect.com

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Review

Does care at a cardiac arrest centre improve outcome after out-of-hospital cardiac arrest? — A systematic review☆

J. Yeung[a,*], *T. Matsuyama*[b], *J. Bray*[c], *J. Reynolds*[d], *M.B. Skrifvars*[e]

[a] Warwick Medical School, University of Warwick, United Kingdom
[b] Department of Emergency Medicine, Kyoto Prefectural University of Medicine, Kyoto, Japan
[c] Department of Epidemiology and Preventive Medicine, Monash University, Melbourne Australia
[d] Department of Emergency Medicine, Michigan State University, Grand Rapids, Michigan, USA
[e] Department of Emergency Care and Services, University of Helsinki and Helsinki University Hospital, Finland

- Only one pilot randomised study
- Meta-analysis of 17 observational studies

Yeung J et al. Resuscitation 2019 Apr;137:102-115

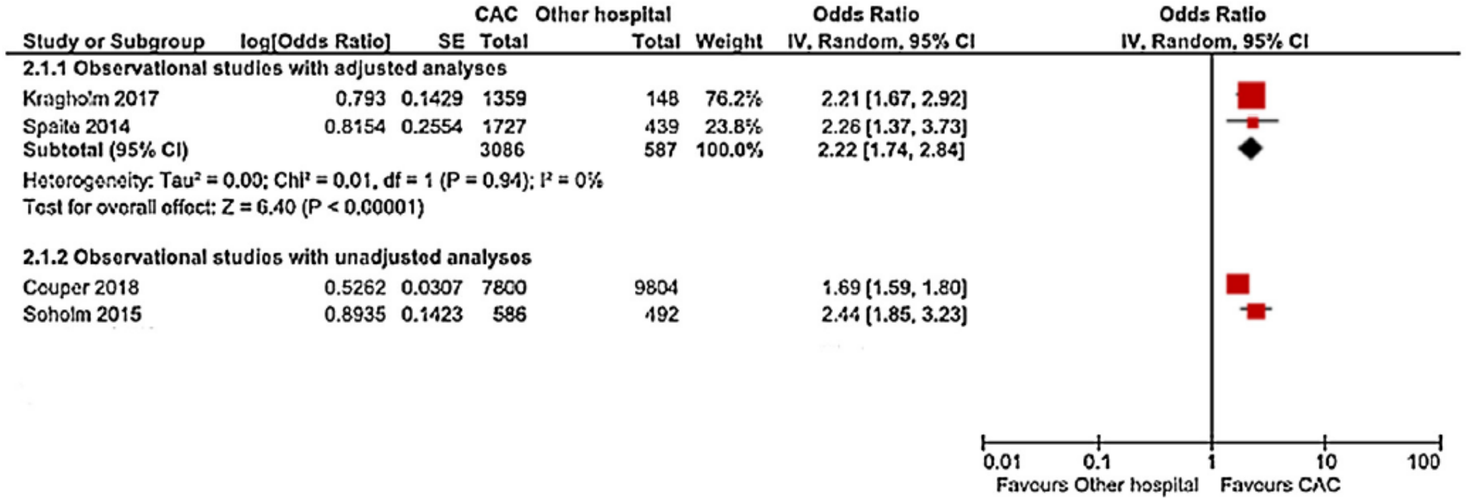


Fig. 3 – Survival to hospital discharge with favourable outcome. Higher odds ratio favours CAC.

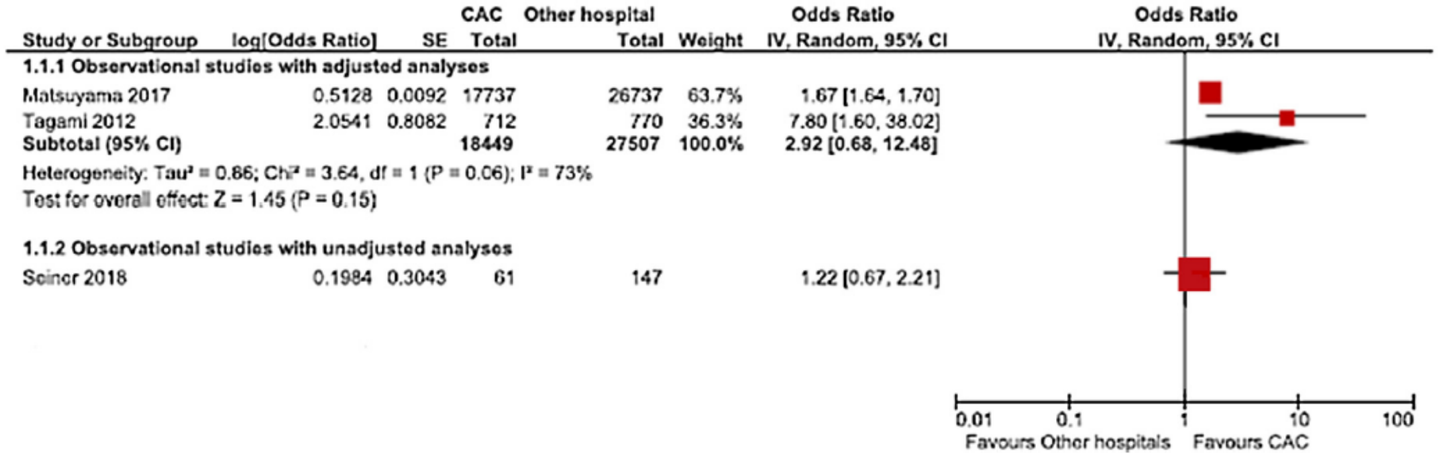


Fig. 2 – Survival to 30 days with favourable outcome. Higher odds ratio favours CAC.

Conclusions

Very low certainty evidence suggests that post-cardiac arrest care at cardiac arrest centres is associated with improved survival with favourable neurological outcome at hospital discharge and improved survival to hospital discharge. Care at CACs did not improve survival to 30 days with favourable neurological outcome and survival to 30 days. There remains a need of high quality data individual patient data meta-analysis and or data from randomised trials to fully elucidate the impact of CAC.

Limitace – riziko bias: velká heterogenita studií; část studií zařadila pacienty s ROSC pouze prehospitalizační; nejsou rozlišeny primární a sekundární transfery do CAC…

Yeung J et al. Resuscitation 2019 Apr;137:102-115

Journal of the American Heart Association

SYSTEMATIC REVIEW AND META-ANALYSIS

Impact of Cardiac Arrest Centers on the Survival of Patients With Nontraumatic Out-of-Hospital Cardiac Arrest: A Systematic Review and Meta-Analysis

Jun Wei Yeo;* Zi Hui Celeste Ng*; Amelia Xin Chun Goh*; Jocelyn Fangjiao Gao; Nan Liu, PhD; Shao Wei Sean Lam, PhD; Yew Woon Chia, MBBS, MMed; Gavin D. Perkins, MD; Marcus Eng Hock Ong, MBBS, MPH;† Andrew Fu Wah Ho, MBBS, MPH, MMed† for the National Targeted Temperature Management Workgroup;‡

- 147 943 patients; 36 studies (1x Czech Rep.)
- nejednotná definice CAC ve zdrojových studiích – rekategorizace „striktní definice CAC“

60. Seiner J, Polášek R, Lejsek J, Strýček M, Karásek J. Cardiac arrest center—one-year experience of the Regional Hospital Liberec. *Cor Vasa*. 2018;60:e234–e238. doi: 10.1016/j.crvasa.2017.08.002

78. Karasek J, Seiner J, Renza M, Salanda F, Moudry M, Strycek M, Lejsek J, Polasek R, Ostadal P. Bypassing out-of-hospital cardiac arrest patients to a regional cardiac center: impact on hemodynamic parameters and outcomes. *Am J Emerg Med*. 2021;44:95–99. doi: 10.1016/j.ajem.2021.01.080

Yeo JW et al. J Am Heart Assoc 2022 Jan 4;11(1):e023806

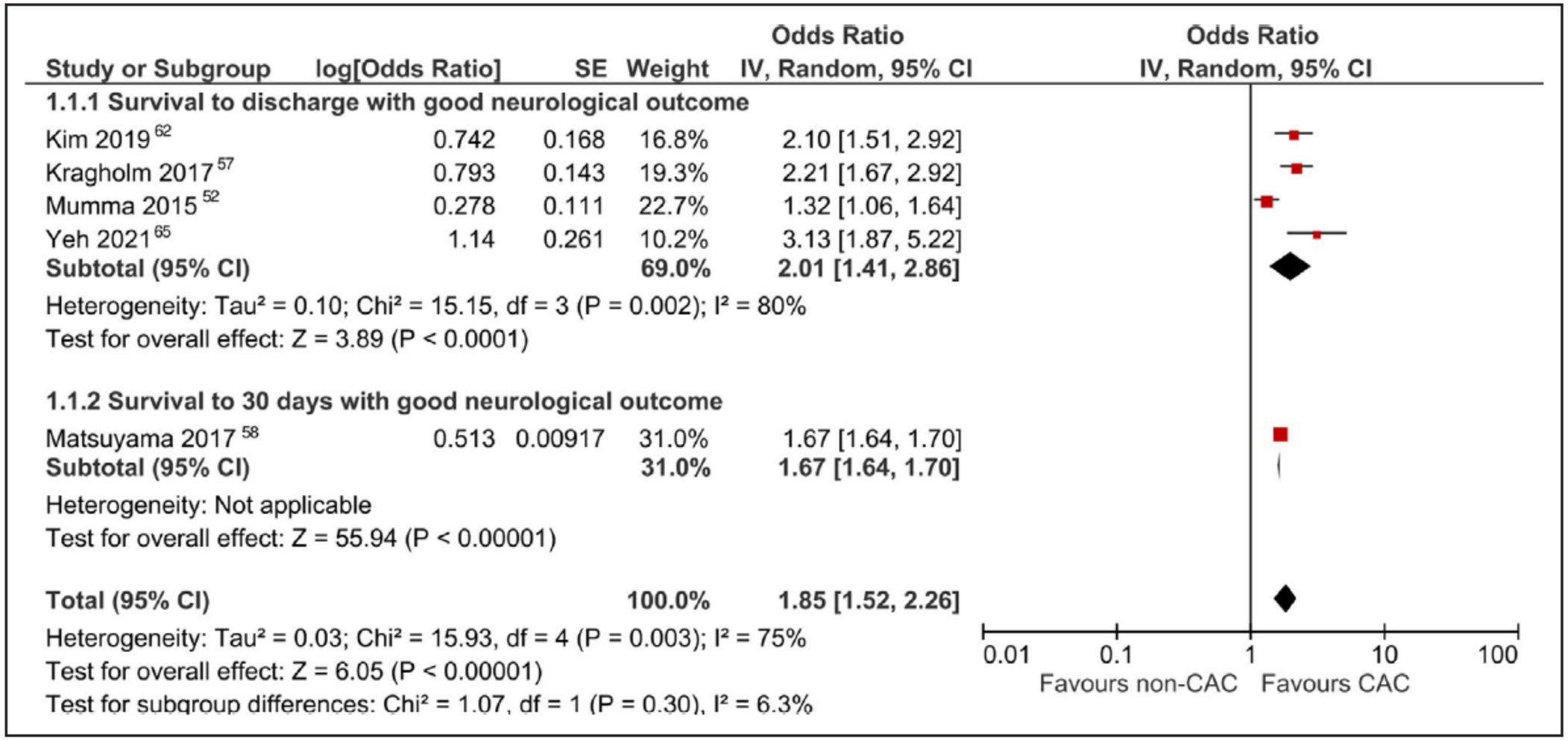


Figure 2. Forest plot for meta-analysis of adjusted analyses comparing survival with good neurological outcome between cardiac arrest centers (CACs) and non-CACs using a random-effects model and the strict definition of CACs.
IV indicates inverse variance.

Yeo JW et al. J Am Heart Assoc 2022 Jan 4;11(1):e023806

Vstupní rytmus

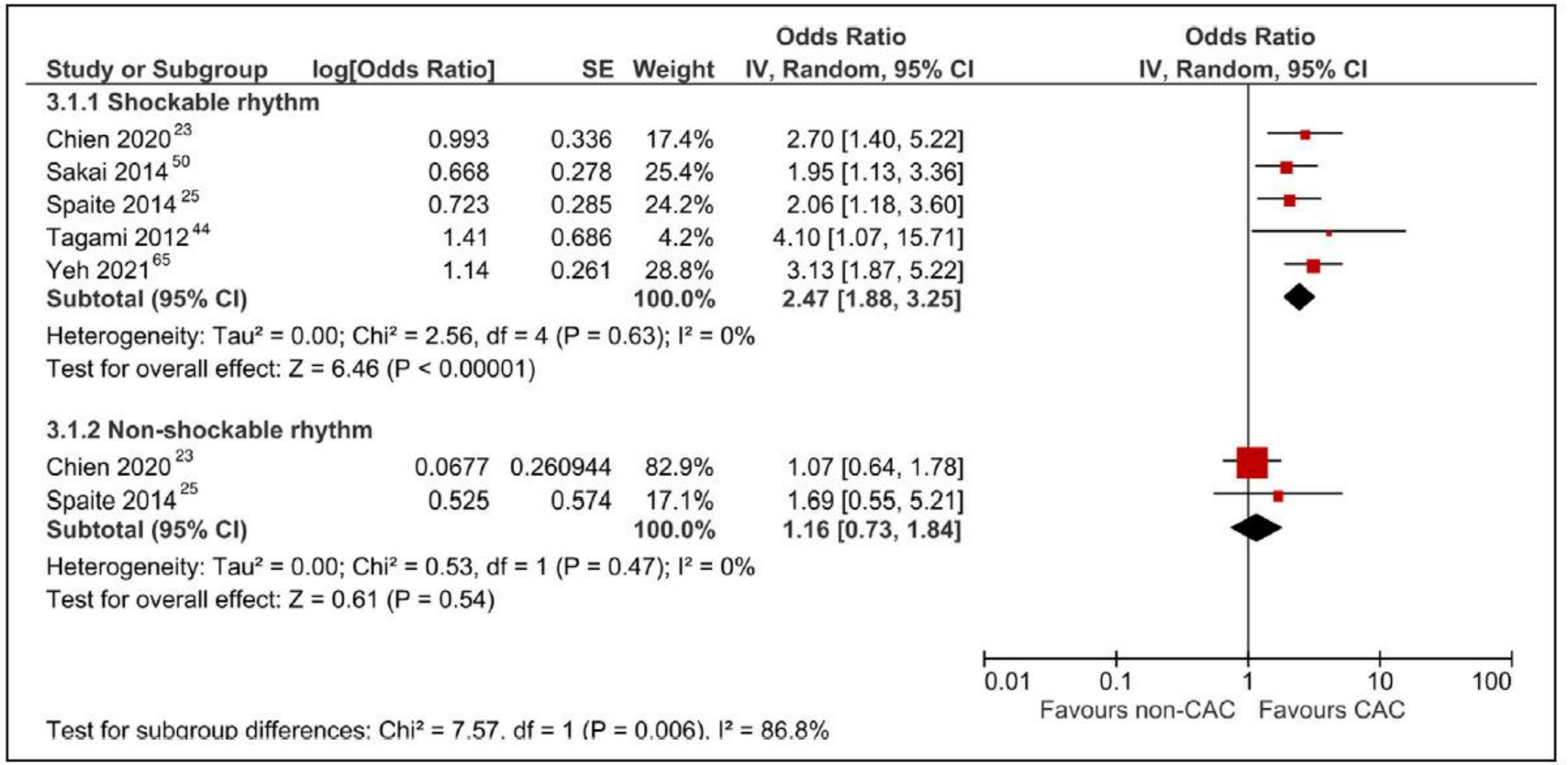


Figure 4. Forest plot for subgroup analysis comparing survival with good neurological outcome between cardiac arrest centers (CACs) and non-CACs within subgroups of patients with shockable and nonshockable rhythm.
IV indicates inverse variance.

Yeo JW et al. J Am Heart Assoc 2022 Jan 4;11(1):e023806

Prehospital ROSC / No prehospital ROSC

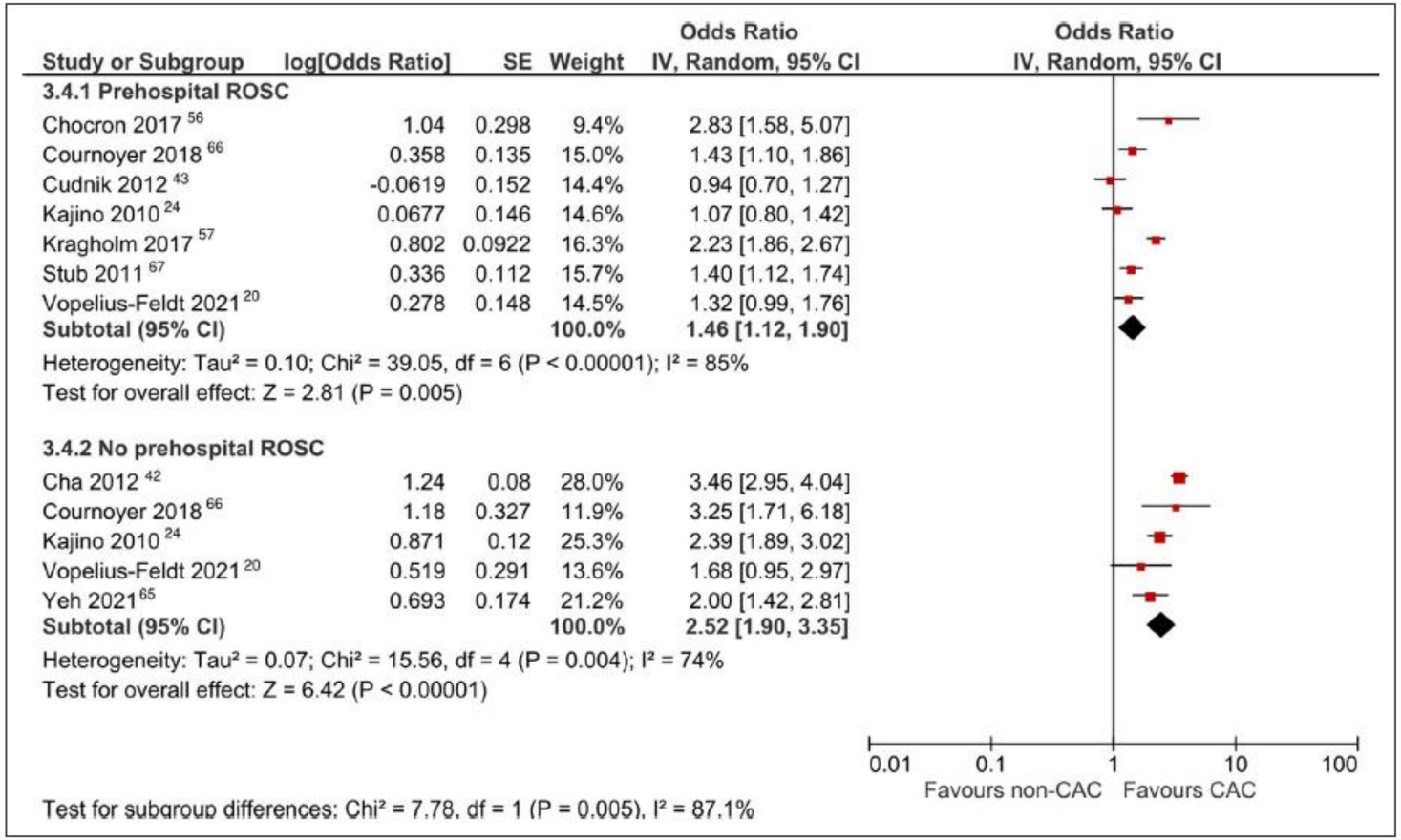


Figure 7. Forest plot for subgroup analysis comparing survival between cardiac arrest centers (CACs) and non-CACs within subgroups of patients with and without prehospital return of spontaneous circulation (ROSC).
IV indicates inverse variance.

Yeo JW et al. J Am Heart Assoc 2022 Jan 4;11(1):e023806

Závěry

- Centra pro srdeční zástavu jsou pracoviště s **adekvátní technologickou a personální kapacitou pro expertní péči o pacienty po oběhové zástavě**.
- Zavedení center pro srdeční zástavu vede ke **zlepšení prognózy** pacientů po OHCA.
- Pro udržení kvality péče je nutné poskytovat péči o pacienty po OHCA v **dostatečném objemu**, nezbytná je kontinuální **monitorace úrovně a výsledků** poskytované péče.
- Nutnost **spolupráce mezi všemi složkami zdravotnického systému** napříč odbornostmi.

DĚKUJEME ZA POZORNOST

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