

# International Initiation and Termination of Resuscitation Practices

- Protocol of a cross-sectional survey

Ulrik Havshøj<sup>1,2,3,\*</sup>, Ida-Marie Dreijer Juhl<sup>2,4</sup>, Louise Milling<sup>1,3</sup>, Jeannett Kjær Jørgensen<sup>1</sup>, Helle Collatz Christensen<sup>5</sup>, Freddy Lippert<sup>5</sup>, Laurie J. Morrison<sup>1,6</sup>, Søren Mikkelsen<sup>1,3</sup>, Anne Craveiro Brøchner<sup>1,2,3</sup>

1 The Prehospital Research Unit, Region of Southern Denmark, Odense University Hospital, Denmark

2: Department of Anesthesiology and Intensive Care Medicine, University Hospital Kolding, Kolding, Denmark

3: Department of Regional Health Research, Region of Southern Denmark, Odense, Denmark

4: Department of Clinical Research, University of Southern Denmark, Odense, Denmark

5: Copenhagen Emergency Medical Services & Danish Clinical Quality Program (RKKP), National Clinical Registries & Department of Clinical Medicine, University of Copenhagen, Copenhagen, Denmark

6: Division of Emergency Medicine, Department of Medicine, University of Toronto,  
Emergency Services, Sunnybrook Health Sciences Center, Toronto, Canada

\*: Corresponding author: mail: Ulrik.havshoj2@rsyd.dk

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## Background

Out-of-hospital cardiac arrest (OHCA) is a leading cause of death in the World (1-4). Substantial international differences in survival to hospital discharge have been reported (4,5); ranging from 0% to 18% in Europe (6,7), 0,5% to 8,5% in Asia (8), 9% to 17% in Australia and New Zealand (9), and from 1.1% to 8.4% in North America (10). Regional differences of up to a fivefold increase in survival have also been reported in multiple settings and geographic locations (11-15).

Neither the international nor the national variation is fully understood but may be attributed to multiple factors such as organization of the Emergency Medical Service (EMS) system (16,17), the response time of the EMS (16), bystander cardiopulmonary resuscitation (CPR)(4,18), and the use of Automatic External Defibrillators (AED's) (4,16,19-20). However, Dyson et al (21) found that the Utstein core factors accounted for only 51% of the global variation in survival to hospital discharge. Supplemental factors accounting for the global variation in survival following OHCA may be variations in the population that are sought resuscitated in each emergency medical system. Transportation rates may vary and the number of patients with OHCA that have their treatment terminated prehospitably may influence the survival. If an EMS initiates resuscitation in all patients with cardiac arrest – even patients with obvious signs of death, different considerations of who to include in the calculations may skew the survival rate. Similarly, local regulations or guidelines concerning the withholding and termination of resuscitation may influence the survival rate when comparing outcomes between different EMS systems (22, 23).

The European Resuscitation Council (ERC) stated in their 2021 guidelines that the EMS systems should define and implement criteria for the withholding and termination of CPR in OHCA, taking into consideration the specific local legal, organizational, and cultural context (24).

Validating Termination-of-Resuscitation guidelines locally could be challenging both ethically and epidemiologically. This would ultimately require a prospective study with a transportation rate of 100%, which would put an immense amount of pressure on the limited sources of the EMS systems.

In this survey, we want to describe the international and national variations in the initiation, the termination of resuscitation, and the refraining from resuscitation of adult patients (>18 years of age) suffering from non-traumatic OHCA. Specifically, we want to describe differences in initiation-,

termination-, and practices of refraining from resuscitation in OHCA and the guidance documents or legislation that govern these practices.

## Method

### Study design

We have developed an online cross-sectional mixed-methods explanatory design survey through feedback from members of the European Prehospital Research Alliance (EUPHOREA), a review of published literature, and following consensus among the authors. The survey is designed in accordance with the CROSS checklist (25) and will be conducted from May 2022 until June 2022.

### Population

Members of the EUPHOREA, the International Liaison Committee of Resuscitation (ILCOR), the European Resuscitation Council, and the Resuscitation Academy are invited to participate. In total, more than 35 countries will be invited. Each invited country will have to identify at least two national experts with special expertise in prehospital resuscitation practices. We exclude countries with less than two respondents.

### Survey

We plan to perform a pilot test of the questionnaire in five countries with divergent EMS systems. This pilot study will enable us to improve the questionnaire. The questionnaire will be modulated following feedback received during the pilot test. If there are major changes, the questionnaire will be tested again in all settings. To maximize data quality, participants will be contacted in case of missing data or major discrepancies in the answers from the same country.

### Data

The database will consist of both qualitative and quantitative data. REDCap, an online questionnaire tool, will be used to share the questionnaire with the participants and to record the data. The survey is conducted using an approved server provided by Odense Patient data Explorative Network (OPEN), at Odense University Hospital and the University of Southern Denmark. Analyses will be conducted using STATA (StataCorp. 2021. *Stata Statistical Software: Release 17*. College Station, TX: StataCorp LLC) and NVivo (qualitative data analysis software; QSR International Pty Ltd. Version 12, 2018). The answers will be anonymized when eligible for analysis.

## Analysis

Prior to the initiation of the study, the questionnaire will be tested among experts, and an agreement regarding the content of the questionnaire is made. If none or only one participant responds on behalf of a country or region, that particular country/region will be ineligible for analysis. Quantitative data will be presented as frequencies and proportions. Qualitative data will be analyzed using content analysis (26).

This study is registered with ClinicalTrials.gov (NCT05029180).

## Perspective

This survey could be of importance in understanding the multiple factors leading to the substantial variation in survival found following OHCA. Understanding both international and regional differences in resuscitation practices and the outcome will help improve EMS system characteristics (4, 11, 27). Using these data and analyses, different countries, regions, and systems may be able to benchmark themselves. Furthermore, the interpretation of future studies on OHCA from different settings may be improved to further increase survival following OHCA.

## Strengths and limitations

The objectiveness in the questions, a reflective stage, and the need for providing evidence when answering, decreases the possibility of perception bias and recall bias. We further consider that it will reduce the risk of any Hawthorne effect and availability bias. Since the questionnaire is only available in English and the provided evidence from respondents may be in their native language, there is a risk of language bias. As the number of respondents is limited, not all the regional differences may be described.

## Ethics

The Danish Health and Medicines Authority has approved the study (Ref. No. 3-3013-3088/1). All regulations of data security will be complied with and are approved by the Region of Southern Denmark (Ref. No. 21/23002). Since this survey regards organizational differences, no formal contact with patients is established.

## Publication

This study will be part of a PhD thesis “Termination of Resuscitation in a physician-manned Emergency Medical System” and published in a peer-reviewed journal with the PhD student as the first author and other authors included according to the Vancouver rules for authorship. The participants of the questionnaire are listed as collaborators in any publications related to this study.

## Conflicts of interest and financial disclosure

The authors have no conflicts of interest and there are no financial relationships related to this study.

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## References

- 1: Rea TD, Eisenberg MS, Sinibaldi G, White RD; Incidence of EMS-treated out-of-hospital cardiac arrest in the United States. *Resuscitation* 2004;63:17–24.
- 2; Vaillancourt C, Stiell IG; Canadian Cardiovascular Outcomes Research Team. Cardiac arrest care and emergency medical services in Canada. *Can J Cardiol.* 2004 Sep;20(11):1081-90. PMID: 15457303.)
- 3: Atwood C, Eisenberg MS, Herlitz J, Rea TD; Incidence of EMS-treated out-of-hospital cardiac arrest in Europe. *Resuscitation* 2005;67:75–80.
- 4: Kiguchi T, Okubo M, Nishiyama C , Maconochie I, Ong M, Kern K, et al; Out-of-hospital cardiac arrest across the World: First report from the International Liaison Committee on Resuscitation (ILCOR). *Resuscitation*. 2020 Jul;152:39-49. doi: 10.1016/j.resuscitation.2020.02.044. Epub 2020 Apr 6. *Resuscitation*. 2020. PMID: 32272235
- 5: Berdowski J, Berg RA, Tijssen JG, Koster RW; Global incidences of out-of-hospital cardiac arrest and survival rates: Systematic review of 67 prospective studies. *Resuscitation*. 2010 Nov;81(11):1479-87. doi: 10.1016/j.resuscitation.2010.08.006. Epub 2010 Sep 9. PMID: 20828914.
- 6 Gräsner JT, Lefering R, Koster R, Masterson S, Böttiger B, Herlitz J, et al; EuReCa ONE; 27 Nations, ONE Europe, ONE Registry. *Resuscitation* 2016;105:188 \_95.
- 7: Gräsner JT, Wnent J, Herlitz J , Perkins G, Lefering R, Tjelmeland I, et al; Survival after out-of-hospital cardiac arrest in Europe - Results of the EuReCa TWO study. *Resuscitation* 148 (2020) 218\_22\_26.  
<https://doi.org/10.1016/j.resuscitation.2019.12.042>
- 8: Ong ME, Shin SD, De Souza NN, Tanaka H, Nishiuchi T, Song KJ, et al; PAROS Clinical Research Network. Outcomes for out-of-hospital cardiac arrests across 7 countries in Asia: The Pan Asian Resuscitation Outcomes Study (PAROS). *Resuscitation*. 2015 Nov;96:100-8. doi: 10.1016/j.resuscitation.2015.07.026. Epub 2015 Jul 30. Erratum in: *Resuscitation*. 2016 Jan;98:125-6. PMID: 26234891.
- 9: Beck B, Bray J, Cameron P, Smith K, Walker T, Grantham H, et al; Aus-ROC Steering Committee. Regional variation in the characteristics, incidence and outcomes of out-of-hospital cardiac arrest in Australia and New Zealand: Results from the Aus-ROC Epistry. *Resuscitation*. 2018 May;126:49-57. doi: 10.1016/j.resuscitation.2018.02.029. Epub 2018 Mar 2. PMID: 29499230.
- 10: Nichol G, Thomas E, Callaway CW, Hedges J, Powell JL, Aufderheide TP, et al; Resuscitation Outcomes Consortium Investigators. Regional variation in out-of-hospital cardiac arrest incidence and outcome. *JAMA*. 2008 Sep 24;300(12):1423-31. doi: 10.1001/jama.300.12.1423. Erratum in: *JAMA*. 2008 Oct 15;300(15):1763. PMID: 18812533; PMCID: PMC3187919.

11: Okubo M, Schmicker R, Wallace D, Idris A, Nichol G, Austin M, et al; Variation in Survival After Out-of-Hospital Cardiac Arrest Between Emergency Medical Services Agencies. *JAMA Cardiol.* 2018;3(10):989-999. doi:10.1001/jamacardio.2018.3037

12: Møller SG, Wissenberg M, Møller-Hansen S, Folke F, Malta Hansen C, Kragholm, et al; Regional variation in out-of-hospital cardiac arrest: Incidence and survival - A nationwide study of regions in Denmark. *Resuscitation.* 2020 Mar 1;148:191-199. doi: 10.1016/j.resuscitation.2020.01.019. Epub 2020 Jan 28. PMID: 32004667.

13: Hiltunen P, Kuisma M, Silfvast T, Rutanen J, Vaahersalo J, Kurola J; Finnresusci Prehospital Study Group. Regional variation and outcome of out-of-hospital cardiac arrest (ohca) in Finland - the Finnresusci study. *Scand J Trauma Resusc Emerg Med.* 2012 Dec 17;20:80. doi: 10.1186/1757-7241-20-80. PMID: 23244620; PMCID: PMC3577470.

14: Okubo M, Gibo K, Wallace DJ, Komukai S, Izawa J, Kiyohara K, et al; Regional variation in functional outcome after out-of-hospital cardiac arrest across 47 prefectures in Japan. *Resuscitation.* 2018 Mar;124:21-28. doi: 10.1016/j.resuscitation.2017.12.030. Epub 2017 Dec 30. PMID: 29294318.

15: Ro YS, Shin SD, Song KJ, Lee EJ, Kim JY, Ahn KO, et al; A trend in epidemiology and outcomes of out-of-hospital cardiac arrest by urbanization level: a nationwide observational study from 2006 to 2010 in South Korea. *Resuscitation.* 2013 May;84(5):547-57. doi: 10.1016/j.resuscitation.2012.12.020. Epub 2013 Jan 8. PMID: 23313428.

16: Tjelmeland I, Masterson S, Herlitz J, Wnent J, Bossaert L, Rosell-Ortiz F, et al; Description of Emergency Medical Services, treatment of cardiac arrest patients and cardiac arrest registries in Europe. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* (2020) 28:103https://doi.org/10.1186/s13049-020-00798-7

17: Govindarajan P, Lin L, Landman A, McMullan JT, McNally BF, Crouch AJ, et al; Practice variability among the EMS systems participating in Cardiac Arrest Registry to Enhance Survival (CARES). *Resuscitation.* 2012 Jan;83(1):76-80. doi: 10.1016/j.resuscitation.2011.06.026. Epub 2011 Jun 30. PMID: 21741432.

18: Sasson C, Rogers MA, Dahl J, Kellermann AL; Predictors of survival from out-of-hospital cardiac arrest: a systematic review and meta-analysis. *Circ Cardiovasc Qual Outcomes.* 2010 Jan;3(1):63-81. doi: 10.1161/CIRCOUTCOMES.109.889576. Epub 2009 Nov 10. PMID: 20123673.

19: Neves Briard J, de Montigny L, Ross D, de Champlain F, Segal E; Is distance to the nearest registered public automated defibrillator associated with the probability of bystander shock for victims of out-of-hospital cardiac arrest? *Prehosp Disaster Med.* 2018;33(2):153-9.

20: Kiyohara K, Nitta M, Sato Y, Kojimahara N, Yamaguchi N, Iwami T, et al; Ten year trends of public-access defibrillation in Japanese school-aged patients having neurologically favorable survival after out-of-hospital cardiac arrest. *Am J Cardiol.* 2018;122(5):890–7.

21: Dyson K, Brown S, May S, Smith K, Koster R, Beesems S, et al; International variation in survival after out-of-hospital cardiac arrest: A validation study of the Utstein template. <https://doi.org/10.1016/j.resuscitation.2019.03.018>. Epub 2019 Mar 18.

22: Eisenberg MS, Cummins RO, Larsen MP; Numerators, denominators, and survival rates: reporting survival from out-of-hospital cardiac arrest. *Am J Emerg Med* 1991;9:544–6.

23: Sasson C, Forman J, Krass D, Macy M, Kellermann A, McNally B; A qualitative study to identify barriers to local implementation of prehospital termination of resuscitation protocols. *Circulation: Cardiovasc Qual Outcomes* 2009;2:361–8.

24: Mentzelopoulos S, Couper K, Van de Voorde P, Druwé, Blom M, Perkins G, et al; European Resuscitation Council Guidelines 2021: Ethics of resuscitation and end of life decisions *Resuscitation* ( 2 0 2 1 ) <https://doi.org/10.1016/j.resuscitation.2021.02.003>

25: Sharma A, Tran Minh Duc N, Luu Lam Thang T, Hai Nam N, Jia Ng S, Abbas K, et al; A Consensus-Based Checklist for Reporting of Survey Studies (CROSS). *J Gen Intern Med* DOI: 10.1007/s11606-021-06737-1

26: Hsieh H-F, Shannon SE; Three approaches to qualitative content analysis. *Qual Health Res* 2005;15:1277–88.

27: Zive D, Koprowicz K, Schmidt T, Stiell I, Sears G, Van Ottingham L, et al; Variation in out-of-hospital cardiac arrest resuscitation and transport practices in the Resuscitation Outcomes Consortium: ROC Epistry—Cardiac Arrest. *Resuscitation* 82 (2011) 277–284 doi:10.1016/j.resuscitation.2010.10.022