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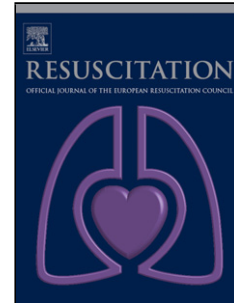
Perception of inappropriate cardiopulmonary resuscitation by clinicians working in emergency departments and ambulance services: The REAPPROPRIATE international, multi-centre, cross sectional survey

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Authors: Patrick Druwé, Koenraad G. Monsieurs, Ruth Piers, James Gagg, Shinji Nakahara, Evan Avraham Alpert, Hans van Schuppen, Gábor Élő, Anatolij Truhlář, Sofie A. Huybrechts, Nicolas Mpotos, Luc-Marie Joly, Theodoros Xanthos, Markus Roessler, Peter Paal, Michael N. Cocchi, Conrad Bjørshol, Monika Pauliková, Jouni Nurmi, Pascual Piñera Salmeron, Radoslaw Owczuk, Hildigunnur Svavarsdóttir, Conor Deasy, Diana Cimpoesu, Marios Ioannides, Pablo Aguilera Fuenzalida, Lisa Kurland, Violetta Raffay, Gal Pachys, Bram Gadeyne, Johan Steen, Stijn Vansteelandt, Peter De Paepe, Dominique D. Benoit

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Perception of inappropriate cardiopulmonary resuscitation by clinicians working in emergency departments and ambulance services: the REAPPROPRIATE international, multi-centre, cross sectional survey

**Author list**

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**Author information**

Department of Intensive Care Medicine, Ghent University Hospital, Ghent, Belgium (Patrick Druwé)

Department of Emergency Medicine, Antwerp University Hospital, Antwerp, Belgium (Koenraad G. Monsieurs)

Department of Geriatric Medicine, Ghent University Hospital, Ghent, Belgium (Ruth Piers)

Department of Emergency Medicine, Musgrove Park Hospital, Taunton and Somerset NHS Foundation Trust, Taunton, United Kingdom (James Gagg)

Teikyo University School of Medicine, Tokyo, Japan (Shinji Nakahara)

Emergency Department, Shaare Zedek Medical Center, Jerusalem, Israel (Evan Avraham Alpert)

Department of Anesthesiology, Amsterdam UMC, University of Amsterdam, Amsterdam, The Netherlands (Hans van Schuppen)

Department of Anaesthesiology and Intensive Therapy, Semmelweis University, Budapest, Hungary (Gábor Élő)

Emergency Medical Services of the Hradec Kralove Region and University Hospital Hradec Kralove, Czech Republic (Anatolij Truhlář)

Department of Emergency Medicine, Antwerp University Hospital, Antwerp, Belgium (Sofie A. Huybrechts)

Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium (Nicolas Mpotos)

Department of Emergency Medicine, Rouen University Hospital, Rouen, France (Luc-Marie Joly)

European University, Nicosia, Cyprus, Hellenic Society of Cardiopulmonary Resuscitation, Athens, Greece (Theodoros Xanthos)

Department of Anaesthesiology, University Medical Centre Göttingen, Göttingen, Germany (Markus Roessler)

Department of Anesthesiology and Critical Care Medicine, University Hospital Innsbruck, Austria (Peter Paal)

Harvard Medical School, Department of Emergency Medicine and Department of Anesthesia Critical Care and Pain Medicine, Division of Critical Care, Beth Israel Deaconess Medical Center, USA (Michael N. Cocchi)

Department of Anesthesiology and Intensive Care, Stavanger University Hospital, The Regional Centre for Emergency Medical Research and Development (RAKOS), Department of Clinical Medicine, University of Bergen, Norway (Conrad Bjørshol)

Department of Anesthesiology and Intensive Care, East Slovak Institute of Oncology, Košice, Slovakia (Monika Pauliková)

Emergency Medicine and Services, Helsinki University Hospital, Helsinki, Finland (Jouni Nurmi)

Hospital General Universitario Reina Sofia, Murcia, Spain (Pascual Piñera Salmeron)

Department of Anaesthesiology and Intensive Therapy, Medical University of Gdansk, Gdansk, Poland (Radoslaw Owczuk)

Akureyri Hospital and University of Akureyri, Akureyri, Iceland (Hildigunnur Svavarsdóttir)

Department of Emergency Medicine, Cork University Hospital, Cork, Republic of Ireland (Conor Deasy)

University of Medicine and Pharmacy Gr.T. Popa and Emergency County Hospital Sf. Spiridon, Iasi, Romania (Diana Cimpoesu)

Nicosia General Hospital, Nicosia, Cyprus (Marios Ioannides)

Pontificia Universidad Católica de Chile, Santiago, Chile (Pablo Aguilera Fuenzalida)

Department of Medical Sciences, Örebro University and Department of Clinical Research and Education, Karolinska Institute, Stockholm, Sweden (Lisa Kurland)

Municipal Institute for Emergency Medicine, Novi Sad, Serbia (Violetta Raffay)

Emergency Department, Shaare Zedek Medical Center, Jerusalem, Israel (Gal Pachys)

Department of Intensive Care Medicine, Ghent University Hospital, Ghent, Belgium (Bram Gadeyne)

Department of Intensive Care Medicine, Ghent University Hospital, Ghent, Belgium (Johan Steen)

Department of Applied Mathematics, Computer Science and Statistics, Faculty of Sciences, Ghent University, Ghent, Belgium and Department of Medical Statistics, London School of Hygiene and Tropical Medicine, London, United Kingdom (Stijn Vansteelandt)

Department of Emergency Medicine, Ghent University Hospital, Ghent, Belgium (Peter De Paepe)

Department of Intensive Care Medicine, Ghent University Hospital, Ghent, Belgium (Dominique D. Benoit)

**Corresponding author information**

Patrick Druwé. Department of Intensive Care Medicine, Ghent University Hospital.

Corneel Heymanslaan 10, Gent, Belgium. Email: [patrick.druwe@ugent.be](mailto:patrick.druwe@ugent.be)

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## ABSTRACT

### Introduction

Cardiopulmonary resuscitation (CPR) is often started irrespective of comorbidity or cause of arrest. We aimed to determine the prevalence of perception of inappropriate CPR of the last cardiac arrest encountered by clinicians working in emergency departments and out-of-hospital, factors associated with perception, and its relation to patient outcome.

### Methods

A cross-sectional survey was conducted in 288 centres in 24 countries. Factors associated with perception of CPR and outcome were analyzed by Cochran-Mantel-Haenszel tests and conditional logistic models.

### Results

Of the 4018 participating clinicians, 3150 (78.4%) perceived their last CPR attempt as appropriate, 548 (13.6%) were uncertain about its appropriateness and 320 (8.0%) perceived inappropriateness; survival to hospital discharge was 370/2412 (15.3%), 8/481 (1.7%) and 8/294 (2.7%) respectively. After adjusting for country, team and clinician's characteristics, the prevalence of perception of inappropriate CPR was higher for a non-shockable initial rhythm (OR 3.76[2.13-6.64]; $P<.0001$ ), a non-witnessed arrest (2.68[1.89-3.79];  $P<.0001$ ), in older patients (2.94[2.18-3.96]; $P<.0001$ , for patients  $>79$  years) and in case of a "poor" first physical impression of the patient (3.45[2.36-5.05]; $P<.0001$ ). In accordance, non-shockable and non-witnessed arrests were both associated with lower survival to hospital discharge (0.33[0.26–0.41]; $P<0.0001$  and 0.25[0.15–0.41]; $P<0.0001$ , respectively), as were older patient age (0.25[0.14–0.44]; $P<0.0001$  for patients  $>79$  years) and a "poor" first physical impression (0.26[0.19–0.35]; $P<0.0001$ ).

### Conclusions

The perception of inappropriate CPR increased when objective indicators of poor prognosis were present and was associated with a low survival to hospital discharge. Factoring clinical judgment into the decision to (not) attempt CPR may reduce harm inflicted by excessive resuscitation attempts.

### Trial Registry

ClinicalTrials.gov; No.: NCT02356029

**Keywords**

Cardiac Arrest; out-of-hospital; Cardiopulmonary Resuscitation; Inappropriate Care; Perception

**Abbreviations**

CPR, cardiopulmonary resuscitation; ROSC, return of spontaneous circulation

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## INTRODUCTION

When cardiopulmonary resuscitation (CPR) was first introduced, it aimed at improving the outcome of patients with clearly reversible conditions such as a myocardial infarction, provided that CPR could be started within the first minutes after collapse.[1] Currently, the majority of cardiac arrest patients are subjected to CPR irrespective of their functional status and comorbidity, the cause of the arrest and the delay after the collapse.[2,3]

Some studies have shown that over time neurologically favourable outcome after CPR has improved, but this improvement is lower for cardiac arrests with an initial non-shockable rhythm compared to those with a shockable rhythm. Data drawn from the Cardiac Arrest Registry to Enhance Survival (CARES) from 2005 until 2012 show an increased adjusted rate of survival to hospital discharge from 2.1 to 3.9% for non-shockable rhythms and from 16.1 to 21.1% for shockable rhythms.[4] A nation-wide Japanese registry from 2005 until 2014 reports an increase of 1-month survival with favourable neurological outcome from 0.8 to 1.2% for bystander-witnessed non-shockable arrests and from 10.1 to 24.9% for bystander-witnessed shockable arrests.[5] Since shockable rhythms constitute approximately 23% of cardiac arrests in European, US and Canadian registries and only 8.6% in Japan,[4-7] this implies that an important proportion of patients is subjected to resuscitation attempts that are disproportional to their expected prognosis in terms of survival and quality of life, from now on referred to as 'inappropriate CPR' attempts.

Previous studies by Marco et al. found in 1995 and again in 2007, that 55% and 57% of surveyed emergency physicians, respectively, reported having attempted more than ten resuscitations that were perceived as futile in the prior three years.[8] Similarly, another survey found that emergency medical technicians estimated 50% of resuscitation attempts to be futile, defined as a very low likelihood of success.[9]

Inappropriate CPR attempts are undesirable from both a personal and a global perspective. Cardiac arrest patients are particularly susceptible to loss of dignity, and as such to dehumanization, because they lack many typical attributes of modern human beings such as consciousness and self-determination. Furthermore, patients who are successfully resuscitated but have substantial residual cognitive, psychological and physical deficits may never recover these attributes, thus prolonging their vulnerability to disrespect, often with profound negative consequences for their relatives.[10] From a global health perspective, undifferentiated application of advanced life support may jeopardize the appropriate allocation of resources.

Studying clinician perceptions of inappropriate care is important since they have been associated with moral distress[11,12] and burnout,[13] which are, in turn, related to self-reported suboptimal patient care practices.[14,15] As such, the quality of future resuscitation attempts may be negatively affected if clinicians repeatedly perceive CPR attempts as inappropriate and resulting in a poor outcome.

To date, no studies have related the clinician's perception of inappropriateness of CPR to actual patient outcomes; the presence of such an association would argue for the soundness of the perception and its value as a decision maker in resuscitation practice.

The primary objective of this study was to determine the prevalence of the uncertainty about CPR appropriateness and of the perception of inappropriate CPR in emergency departments and out-of-hospital, and the association with survival to hospital discharge. The secondary objective was to assess the association between patient- and situation-related factors, clinician characteristics, organizational and work-related factors, and the perception of inappropriate CPR, return of spontaneous circulation (ROSC), and survival to hospital discharge.

## **METHODS**

### **Study design and participants**

The REAPPROPRIATE study is an international multi-centre cross-sectional survey conducted in 288 centres in 24 countries (Austria, Belgium, Chile, Cyprus, Czech Republic, Finland, France, Germany, Greece, Hungary, Iceland, Israel, Japan, The Netherlands, Norway, Poland, Republic of Ireland, Romania, Serbia, Slovak Republic, Spain, Sweden, the United Kingdom and the United States). The study population consisted of clinicians who are directly involved in the treatment of cardiac arrest in the emergency department or the prehospital setting (Table 1). The data collection took place from March 2015 until November 2015.

A network of national coordinators was created by contacts within the European Resuscitation Council (ERC) and by direct invitation. National coordinators had a lead position in a national or international scientific organization or conducted research related to emergency medicine. National coordinators were responsible for 1)

recruiting emergency departments and ambulance services 2) organizing the translation of the survey in the first national language using a modified Brislin's method[16] 3) Institutional Review Board approval 4) co-operating with local investigators to ensure access to a secured study website and 5) providing assistance to the local investigators during data collection. Local investigators informed and motivated local clinicians to participate.

### **Survey**

The survey was modified based on a validated questionnaire used in the APPROPRICUS Study[17] and extended to the setting of emergency medicine. A modified Delphi method was used to adjust the questionnaire. First, a Dutch version of the questionnaire was prepared by a multidisciplinary expert panel: two emergency physicians, two intensivists, two emergency nurses, one geriatrician, and two clinical psychologists. This Dutch version was piloted among 247 clinicians in Flanders.[18] After adaptation and translation into English, five native speakers performed a linguistic revision (four emergency physicians, one emergency nurse). Second, final adaptations were made during face-to-face meetings of the multidisciplinary expert panel with in-depth discussion of feedback received from the national coordinators to achieve a broadly agreed questionnaire. This final English questionnaire was translated into the language of each participating country using an adapted Brislin's method with translation and back-translation followed by re-translation if necessary to achieve cultural and functional equivalence.[16]

### **Description of the survey**

Clinicians were asked about their demographic and professional background and working environment. If applicable a 4-point rating scale ranging from "Fully agree" to "Fully disagree" was used. Clinicians were asked to recall the last cardiac arrest they encountered and to answer first whether they "fully agreed with starting the resuscitation" (perception of appropriate CPR), "were unsure resuscitation should have been started" (uncertain about appropriateness of CPR) or "were sure resuscitation should not have been started" (perception of inappropriate CPR). Subsequently respondents were asked about details of the resuscitation circumstances such as site of arrest, patient age, gender, initial rhythm, presence of a witness, ROSC, first impression of the patient's physical condition, probable cause of arrest and at the very end whether the patient was discharged alive from hospital. All survey items are listed in Supplemental Tables 1, 2 and 3.

The prevalence of perception of inappropriate CPR was defined as the percentage of clinicians reporting perception of inappropriate CPR in the last emergency department or out-of-hospital CPR they performed.

## Statistical Analysis

### *Bivariate analysis*

Bivariate associations between the three perception outcomes (perception of appropriate CPR, uncertainty about appropriateness of CPR, and perception of inappropriate CPR), ROSC and survival to hospital discharge on the one hand, and patient's, arrest, clinician's and clinician's perceived team and work environment characteristics on the other hand, were subjected to Cochran Mantel Haenszel tests (assuming homogeneity of odds ratios across centres and discarding 'Don't know' response categories) to account for the hierarchical data structure and differences in patient and clinician case-mix across centres (Supplemental Tables 1 to 3).

### *Multivariate analysis*

To obtain a more comprehensive overview of relevant factors associated with perception of appropriateness of CPR and to account for variability due to patient and clinician case-mix across centres, adjusted within-centre odds ratios were estimated for each of the three perception outcomes. These were obtained from three corresponding conditional logistic regression models, each including the same set of adjustment covariates, which was selected by a backward stepwise elimination procedure as described in more detail in the Supplemental material Appendix B.

The resulting odds ratios of these conditional models quantify *within*-centre associations between perceptions of appropriateness, on the one hand, and patient's, arrest, clinician's and clinician's perceived team and work environment characteristics, on the other hand. Furthermore, we assessed to what extent variability in perceptions can be attributed to variability in patient and clinician case-mix *between* centres. By considering appropriateness response categories as discrete manifestations of a single continuous latent construct, such variance partitioning could be obtained by a mixed effects modeling approach.[19] Explained variance related to (i) regional and organizational differences between centres was separated from variance explained by (ii) within-centre differences in patient's and arrest characteristics and by (iii) within-centre differences in clinician's and clinician's perceived team characteristics. For additional details of this adapted variance partitioning approach we refer to the Supplemental material Appendix B.

All analyses were performed in R 3.4.3 (R Foundation for Statistical Computing, Vienna, Austria).

### **Compliance with ethical standards**

This study was conducted in accordance with the Declaration of Helsinki. Unless informed consent was not required, the study was approved by the Institutional Review Board of all participating countries. To guarantee data safety a HyperText Transfer Protocol Secure website <https://reappropriate.eu> was designed and signed by a trusted certificate authority, allowing encryption of all transferred data.

## RESULTS

The last CPR attempt encountered was reported by 4123 clinicians. One hundred and five CPR attempts could not be analyzed due to an unforeseen error in the electronic survey system which occurred at random, leaving 4018 CPR attempts for final analysis. Doctors, nurses and emergency medical technicians (paramedics) accounted for 1481 (36.9%), 1009 (25.1%) and 1528 (38.0%) of surveyed clinicians, respectively (Table 1).

Of the 4018 participating clinicians, 3150 (78.4%) perceived their last CPR attempt as appropriate, 548 (13.6%) were uncertain about its appropriateness and 320 (8.0%) perceived CPR as inappropriate. ROSC for each of the perception outcomes was 1409/2892 (48.7%), 139/513 (27.1%) and 54/302 (17.9%) respectively, and survival to hospital discharge was 370/2412 (15.3%), 8/481 (1.7%) and 8/294 (2.7%) respectively (Fig. 1). Survival to hospital discharge was known for 1021/1602 (63.7%) patients with ROSC and was respectively 361/881 (41.0%), 8/99 (8.1%) and 7/41 (17.1%) for each of the perception outcomes.

Initial non-shockable rhythms accounted for 2489/3421 (72.7%) of CPR attempts; 870/2489 (35.0%) were non-witnessed. Of the 870 clinicians treating a non-shockable, non-witnessed cardiac arrest, 558 (64.1%) perceived their CPR attempt as appropriate, 182 (20.9%) were uncertain about its appropriateness and 130 (14.9%) perceived inappropriateness; survival to hospital discharge was 17/773 (2.2%) (Fig. 2).

In non-shockable non-witnessed cardiac arrests, patients older than 80 and 90 years accounted for 219/870 (25.2%) and 42/870 (4.8%) of cardiac arrest attempts respectively; 100/219 (45.7%) and 14/42 (33.3%) of the clinicians perceived these CPR attempts as appropriate, 67/219 (30.6%) and 16/42 (38.1%) were uncertain about its appropriateness, 52/219 (23.7%) and 12/42 (28.6%) perceived CPR as inappropriate; survival to hospital discharge was 1/202 (0.5%) and 0/40 (0.0%) respectively.

Factors independently associated with the three perception outcome categories, ROSC and survival to hospital discharge are shown in Fig. 3 and 4. Corresponding numerical estimates, 95% confidence intervals and significance tests can be found in the Supplement Tables 4 and 5. The prevalence of both uncertainty about the

appropriateness of CPR and of perception of inappropriate CPR was significantly higher for cardiac arrests with a non-shockable initial rhythm (OR=1.89 [95% CI 1.35–2.64];  $P<.0001$  and OR=3.76 [95% CI 2.13–6.64];  $P<.0001$ , respectively), that were non-witnessed (OR=2.19 [95% CI 1.70–2.83];  $P<.0001$  and OR=2.68 [95% CI 1.89–3.79];  $P<.0001$ , respectively), in older patients (OR=3.09 [95% CI 2.45–3.90];  $P<.0001$  and OR=2.94 [95% CI 2.18–3.96];  $P<.0001$ , respectively, for patients older than 79 years of age) and in patients whose first physical impression was rated “bad” to “poor” by the reporting clinician (OR=3.70 [95% CI 2.78–4.94];  $P<.0001$  and OR=3.45 [95% CI 2.36–5.05];  $P<.0001$ , respectively). In accordance, non-shockable and non-witnessed arrests were both associated with lower survival to hospital discharge (OR=0.33 [95% CI 0.26–0.41];  $P<.0001$  and OR=0.25 [95% CI 0.15–0.41];  $P<.0001$ , respectively), as were older patient age (OR=0.25 [95% CI 0.14–0.44];  $P<.0001$  for patients older than 79 years of age) and “bad” to “poor” first physical impression (OR=0.26 [95% CI 0.19–0.35];  $P<.0001$ ).

No significant associations were found between the profession of the clinician and the three perception outcome categories: appropriateness ( $P=0.51$ ), uncertainty ( $P=0.81$ ) and inappropriateness ( $P=0.49$ ). Older clinician’s age was negatively associated with perceptions of appropriate CPR (OR=0.43 [95% CI 0.23–0.80];  $P=.008$  for clinicians older than 59 years of age), not significantly associated with uncertainty about appropriateness (OR=1.62 [95% CI 0.80–3.26];  $P=0.18$ ) and positively associated with perceptions of inappropriateness of CPR (OR=2.73 [95% CI 1.15–6.47];  $P=0.02$ ). The delay between the last CPR attempt and the survey completion was not significantly different with the three perception outcome categories ( $P=0.84$ ).

Eight to 11.7% of variance in the three perception outcome categories could be explained by regional and organizational differences between centres, 1.7% to 10.5% by within-centre variability in clinician’s characteristics and clinician’s perceived team characteristics, and 21.5% to 30.3% by within-centre patient- and situation-related variability (Supplement Table 6).

## DISCUSSION

To our knowledge, this is the first large international multi-centre study focusing on perception of inappropriateness of CPR, incorporating most clinical professions involved in cardiac arrest care, exploring potentially relevant organizational, clinician- and work-related factors, as well as patient- and situation-related factors, and relating these factors with patient outcome. Clinicians were specifically asked about the last cardiac arrest they encountered. As such the reported prevalence of perception of inappropriate CPR is based on a specific clinical event attended by the clinicians and not just on a vague general impression.

With this cross-sectional survey, we found that 78.4% of clinicians working in emergency departments and ambulance services perceived their last CPR attempt as appropriate, 13.6% were uncertain about its appropriateness, and 8.0% perceived their last CPR attempt as inappropriate. Moreover, we found that the presence of objective indicators of poor prognosis only moderately increased the prevalence of perception of inappropriate CPR but also the prevalence of uncertainty about appropriateness of CPR. Even in patients with non-witnessed non-shockable arrests, a group known for its highly unfavourable prognosis[4,20] and a survival to hospital discharge of 2.2% in our series, only 14.9% of clinicians considered it inappropriate to perform CPR. Unexpectedly, the presence of these indicators also increased the prevalence of uncertainty about appropriateness of CPR. These findings indicate that the majority of clinicians are either unaware of the inappropriateness of their CPR attempt or only become aware of the potential consequences of their actions in extreme patient situations.

The most important determinants of perception of inappropriate CPR were objective criteria such as non-shockable initial rhythm, non-witnessed arrest, older age and a poor first physical impression of the patient. In contrast, clinician- and organization-related factors such as profession or job strain only accounted for a small part of the variance in perception. This may indicate that perception of inappropriateness of CPR could be mainly reduced by better factoring the well-established objective criteria of poor prognosis reported in the literature into the decision to attempt resuscitation.[4,20] Although it would be undesirable to withhold resuscitation attempts in all patients with objective criteria of unfavourable prognosis, there is no doubt that a substantial proportion of these patients are currently resuscitated without any realistic perspective of survival. For instance, in our series, very few to none of the patients older than 80 years of age with a non-witnessed non-shockable arrest survived to hospital discharge. This suggests that patient selection is suboptimal and should be improved in order to prevent additional harm.[21]

Current guidelines and algorithms only allow refraining from resuscitation when irreversible signs of death or a written advance directive are present.[22] As such, they disregard the added value of clinical insight by healthcare professionals and the fact that uncertainty is inherent to the complexity of every clinical situation, cardiac arrest not being an exception to this rule.[12] Clinicians also use heuristic decision making in the context of resuscitation which not only includes observation of objective factors and application of scientific

data, but also ‘tacit’ knowledge based on acquired expertise and pattern recognition.[23] According to our data, both uncertainty about the appropriateness of a CPR attempt and perception of inappropriate CPR by clinicians seems to be largely concordant with patient outcome and not influenced by their profession, suggesting the importance of clinical appraisal and warranting team leaders to invite and take into account the opinion of all experienced resuscitation team members, regardless of their role.

Our results highlight the need of closed-loop systems assuring that all clinicians involved in a resuscitation receive feedback on the results of their attempts. Debriefing and interdisciplinary ethical reflection on difficult patient cases are needed, more specifically when one or more team members have doubts about the appropriateness of resuscitation. Ongoing research on Patient Reported Outcomes in the field of cardiac arrest will provide clinicians with additional perspectives to better tailor resuscitation attempts to outcomes desirable for patients.[24,25] More advance care planning conversations with patients and family are needed,[26] based on realistic information about outcome of resuscitation thus avoiding inaccurate expectations of CPR.[27] Compliance of clinicians once advance directives are established should be further improved.[8,28]

This study has several limitations. First, the possibility that perceptions about appropriateness of CPR may have been affected by recall of the resuscitation outcome cannot be excluded. However, the questionnaire was structured in such a way that questions concerning outcome were listed at the very end. Importantly, statistical adjustment for ROSC did not affect our main findings (see Supplemental Fig. 1). However, even when recall bias would be an issue, the observed low prevalence of perception of inappropriate CPR, even in patients with a poor outcome, emphasizes the ‘CPR by default’ mindset of clinicians. Second, data on ROSC and survival to hospital discharge were provided solely by the clinician. Third, due to the organizational heterogeneity of the participating centres it was impossible to calculate the response rates. However, survival to hospital discharge according to initial rhythm and presence of a witness reported in this study are consistent with the literature which underpins a representative sample provided by the participating clinicians.[4,7,29,30]. Differences in response rates between centres were moreover adjusted for via random centre effects in a hierarchical model. Both these points give reassurance that, even if the response rate in certain centres was low to very low, the associations between the outcomes and the objective patient and arrest characteristics provided by the participating clinicians may not be distorted by this shortcoming.



**Conclusion**

Our findings suggest that experienced clinicians who are uncertain about CPR appropriateness or perceive CPR as inappropriate deserve to be acknowledged, irrespective of their profession. Factoring this clinical judgment into the decision to attempt resuscitation may reduce harm inflicted by excessive resuscitation attempts to a substantial number of patients, facilitating a more dignified death for many.

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**Conflicts of interest**

J.G. received honoraria from Boehringer Ingelheim within the last 3 years. C.A.B. is employed by the Regional Competence Centre for Acute Medicine in Western Norway (RAKOS) with financial support from the Norwegian Directorate of Health. He has participated in Global Resuscitation Alliance meetings sponsored by the Laerdal Foundation for Acute Medicine, TrygFonden and EMS2018. C.D. is Deputy Medical Director of the National Ambulance Service of the Republic of Ireland. The other authors declared no conflicts of interest.

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**Author contributions**

P.D., K.M., R.P., S.H., P.D.P. and D.D.B. designed the study. All authors except J.S. and S.V.S. contributed to the final version of the survey. All authors except K.M., R.P., J.S., S.V.S., P.D.P. and D.B. contributed to the data collection. P.D., K.M., R.P., P.D.P., D.D.B., J.S. and S.V.S. analyzed and interpreted the data. J.S. and S.V.S. performed the statistical analysis. P.D. did the literature search and wrote the first draft of the report. P.D. and J.S. structured Tables and Figures. All authors reviewed the draft, contributed to the revision of the report and approved the final version of the report.

**Other contributions**

We are grateful to Bo Van den Bulcke and An Lievrouw, clinical psychologists for their contribution when building the survey and to Drs. Scott Grier and Richard Jeavons for the linguistic revision of the survey. The ERC Research Net was helpful in facilitating the European part of our research network. We thank Melissa Maebe for her secretarial assistance.

National coordinators and local investigators are listed in Supplemental material Appendix A.

**Data sharing statement**

Survey data reported in this article are available on request from the corresponding author.

**Supplementary data**

Supplementary data associated with this article can be found, in the online version, at ...

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## References

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**Legends to figures**

**Fig. 1** Flowchart of survey inclusion, prevalence of perception of (in)appropriateness of CPR, ROSC and survival to hospital discharge

*CPR* cardiopulmonary resuscitation, *ROSC* return of spontaneous circulation

**Fig. 2** Cardiac arrest characteristics versus appropriateness of CPR outcome categories, ROSC and survival to hospital discharge

Initial rhythm and witness status known for 3421/4018 cases; ROSC status known for 3200/3421 cases; survival to hospital discharge status known for 2746/3421 cases

P-values for corresponding Cochran Mantel Haenszel tests (assuming homogeneity of odds ratios across centres and discarding ‘don’t know’ response categories)

ROSC and survival to hospital discharge data are n/N (%)

*CPR* cardiopulmonary resuscitation, *ROSC* return of spontaneous circulation

**Fig. 3** Point and 95% confidence interval estimate plots for adjusted odds ratios relating levels of each of the retained covariates with each of the appropriateness of CPR outcome categories (logarithmic scale)

Job Strain Social Support not tabulated since meaningful interpretation and comparison with other effect sizes was not possible

Wherever applicable, odds ratios are expressed relative to the indicated baseline category

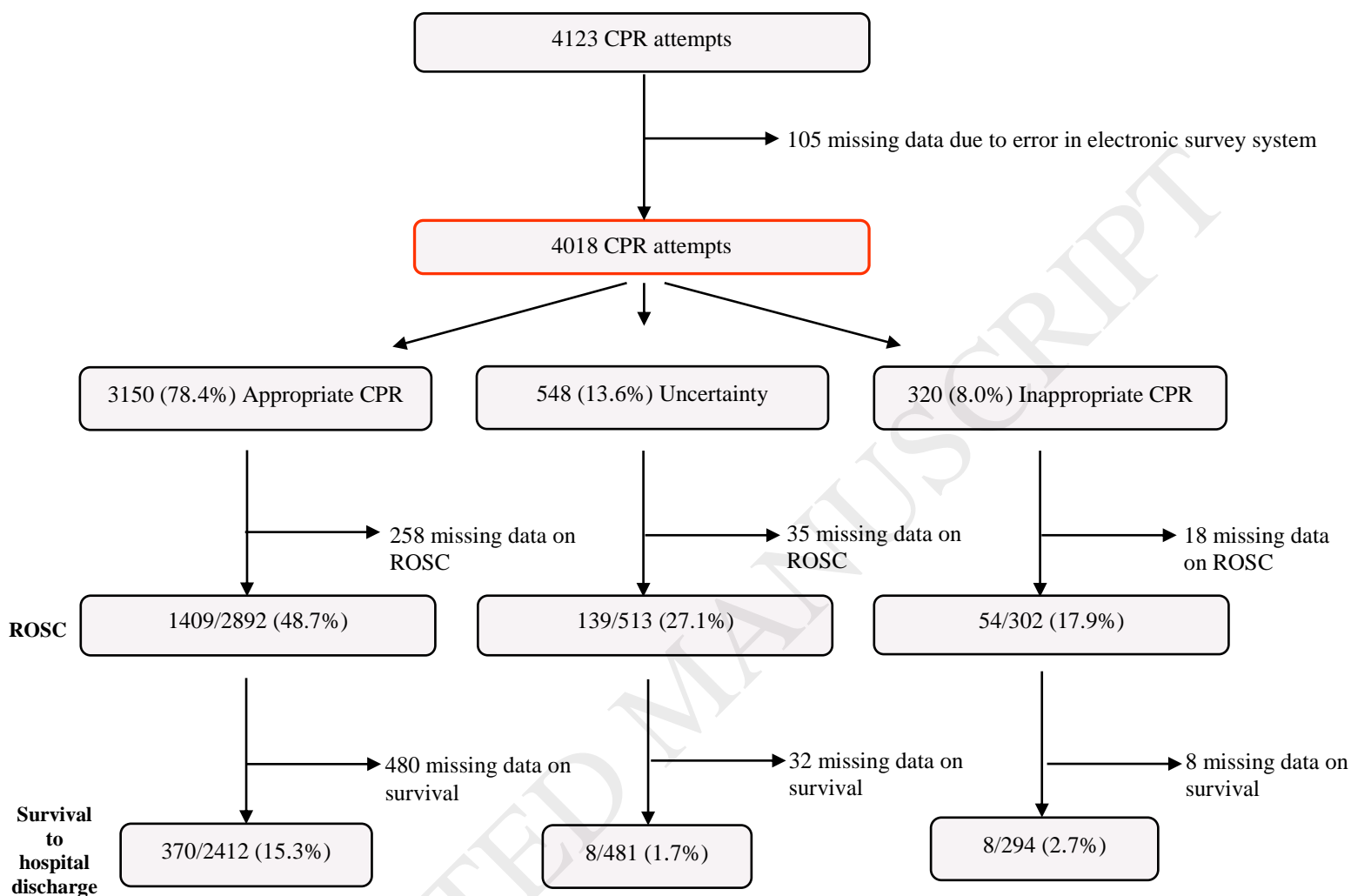
*CPR* cardiopulmonary resuscitation, *EMT* emergency medical technician (paramedic)

**Fig. 4** Point and 95% confidence interval estimate plots for adjusted odds ratios relating levels of each of the retained covariates with ROSC (return of spontaneous circulation) and survival to hospital discharge (logarithmic scale)

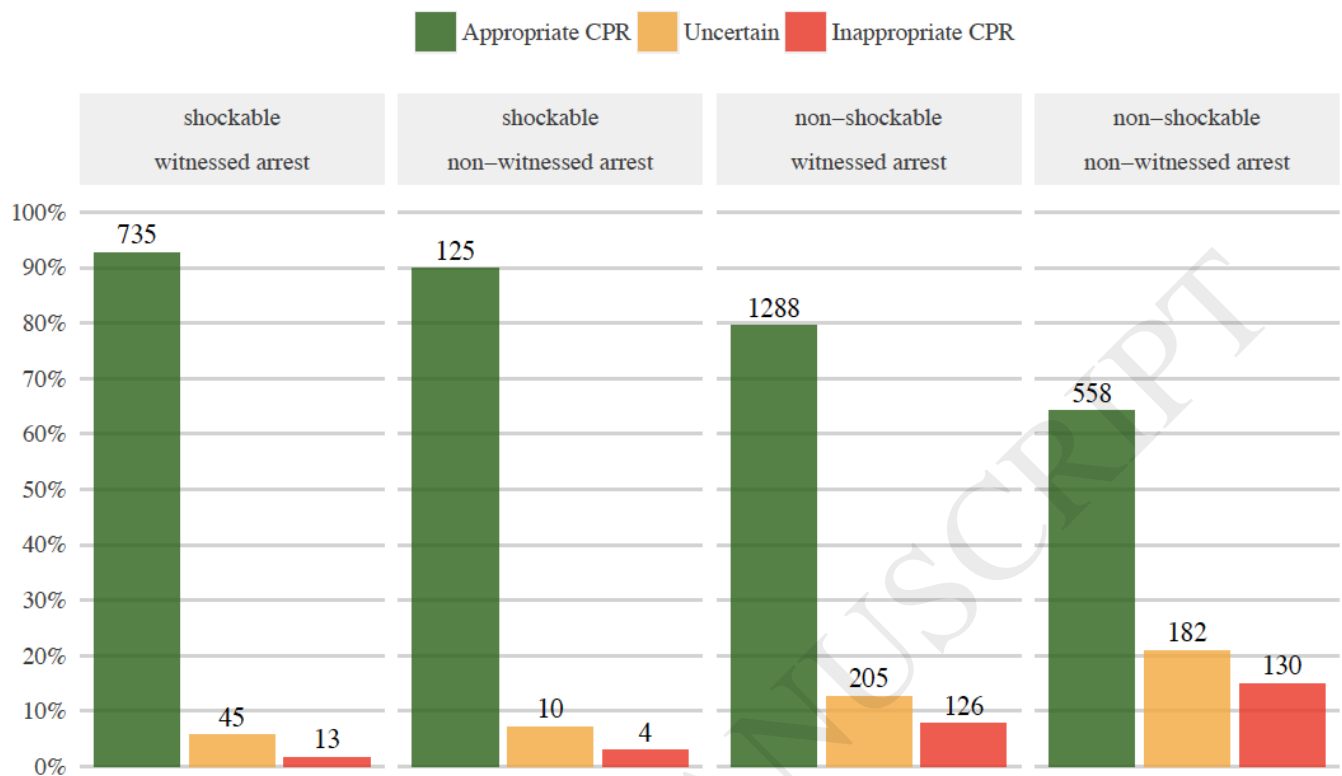
Job Strain Social Support not tabulated since meaningful interpretation and comparison with other effect sizes was not possible

Wherever applicable, odds ratios are expressed relative to the indicated baseline category

*CPR* cardiopulmonary resuscitation, *EMT* emergency medical technician (paramedic)



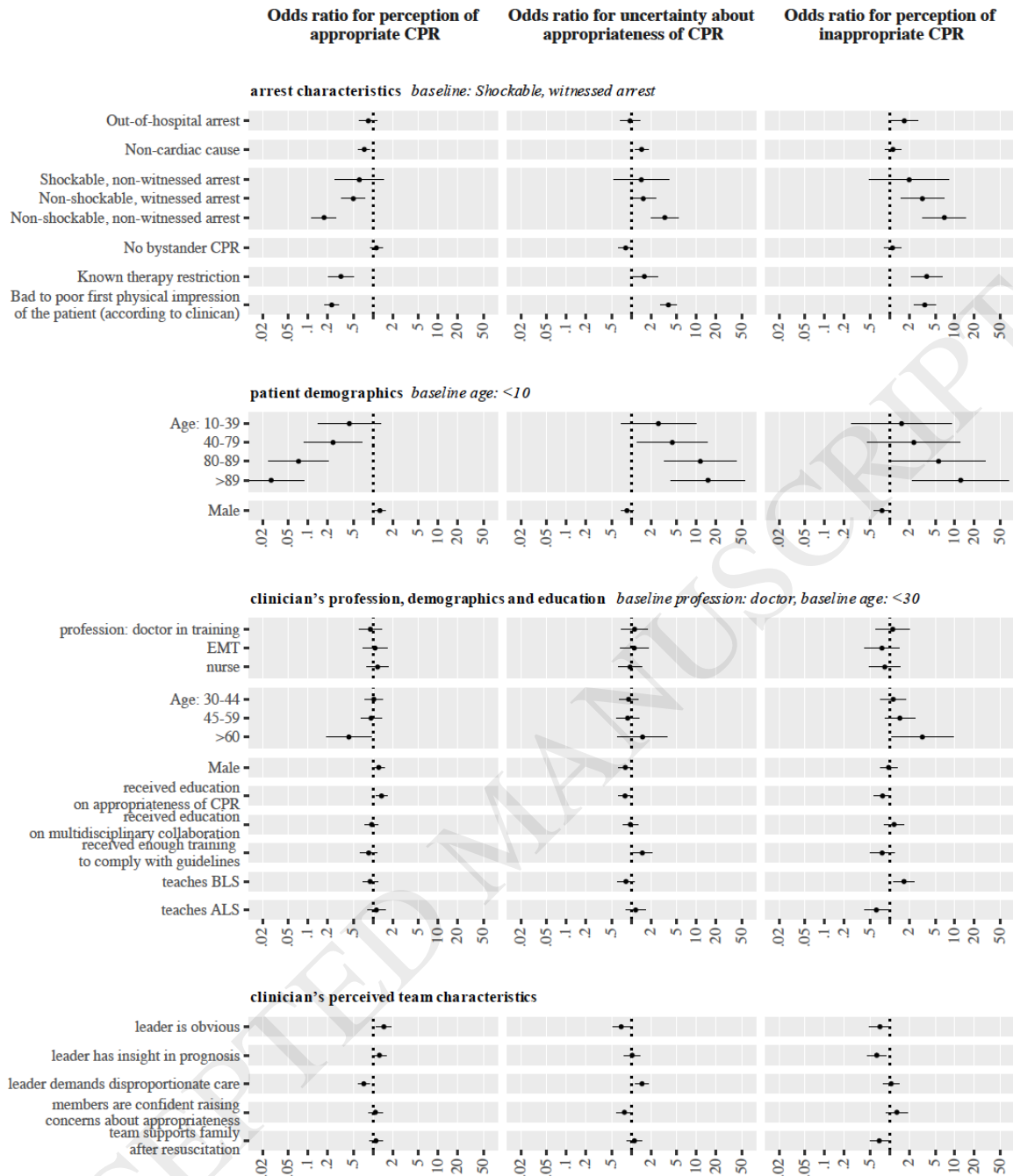
**Fig. 1** Flowchart of survey inclusion, prevalence of perception of (in)appropriateness of CPR, ROSC and survival to hospital discharge



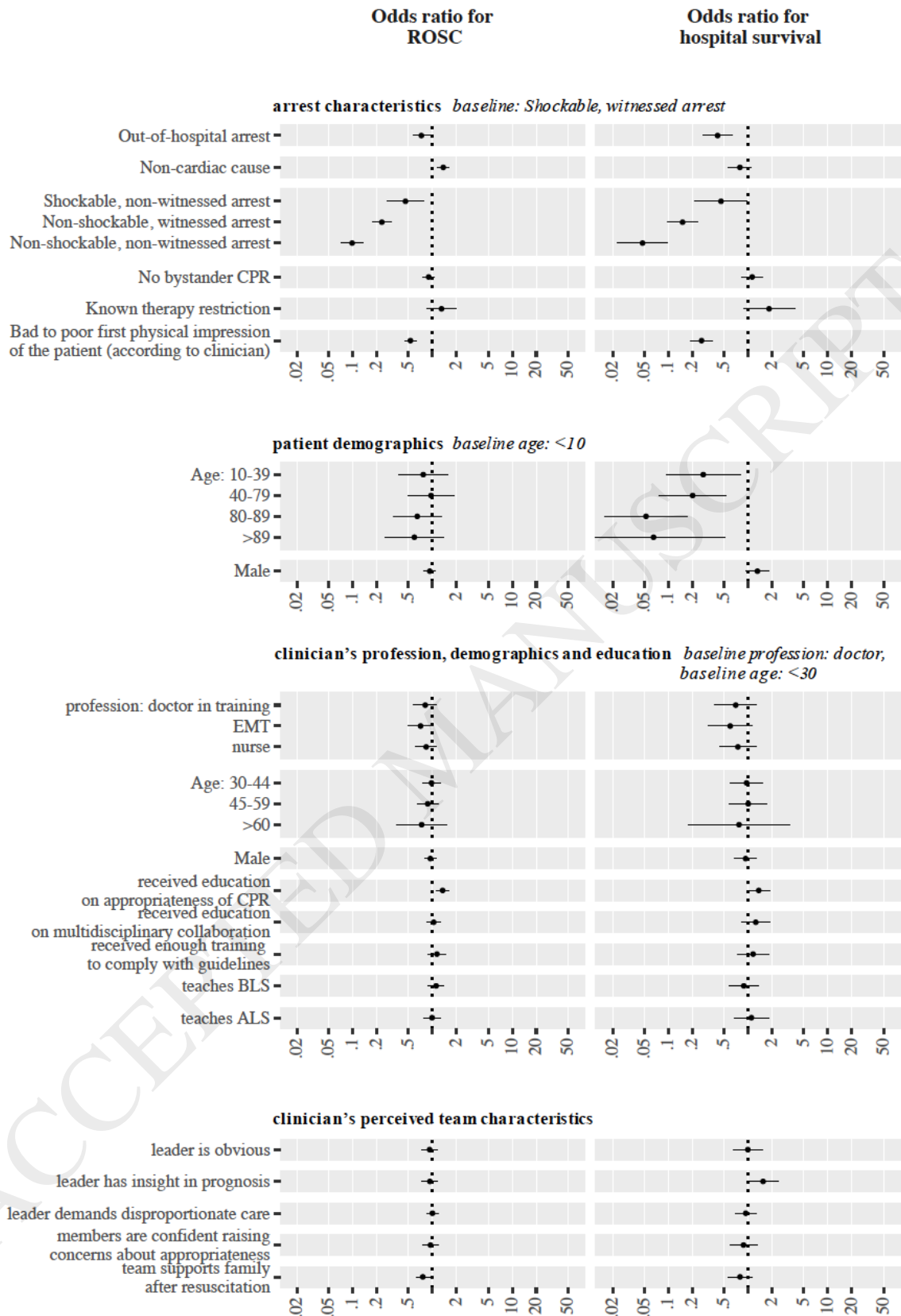
ROSC	537/738 (72.8%)	79/133 (59.4%)	579/1511 (38.3%)	179/818 (21.9%)
Survival to hospital discharge	199/518 (38.4%)	27/109 (24.8%)	86/1346 (6.3%)	17/773 (2.2%)

**Fig. 2** Cardiac arrest characteristics versus appropriateness of CPR outcome categories, ROSC and survival to hospital discharge.





**Fig. 3** Point and 95% confidence interval estimate plots for adjusted odds ratios relating levels of each of the retained covariates with each of the appropriateness of CPR outcome categories (logarithmic scale).



**Fig 4** Point and 95% confidence interval estimate plots for adjusted odds ratios relating levels of each of the retained covariates with ROSC (Return of Spontaneous Circulation) and survival to hospital discharge (logarithmic scale)

**Table 1**

Participating countries, centres and clinicians

Region N=5	Country N=24	Centres N=288	Clinicians N=4018	Doctors N=1481 n (%)	Nurses N=1009 n (%)	EMT N=1528 n (%)
Western Europe N=1681	Austria	6 ED/16 AS	185	64 (34.6)	17 (9.2)	104 (56.2)
	Belgium	12 ED/19 AS	253	85 (33.6)	117 (46.2)	51 (20.2)
	France	15 ED/8 AS	209	105 (50.2)	78 (37.3)	26 (12.4)
	Germany	13 AS	189	67 (35.4)	0 (0.0)	122 (64.6)
	The Netherlands	5 ED/10 AS	317	42 (13.2)	107 (33.8)	168 (53.0)
	Republic of Ireland	7 ED/1 AS/3 <sup>a</sup>	63	31 (49.2)	30 (47.6)	2 (3.2)
	United Kingdom	11 ED/4 AS	465	106 (22.8)	84 (18.1)	275 (59.1)
Central Europe N=885	Czech Republic	4 ED/8 AS	292	108 (37.0)	48 (16.4)	136 (46.6)
	Hungary	8 ED/3 AS	306	122 (39.9)	124 (40.5)	60 (19.6)
	Poland	4 ED/6 AS	104	37 (35.6)	22 (21.2)	45 (43.3)
	Romania	1 ED	56	45 (80.4)	10 (17.9)	1 (1.8)
	Serbia	1 AS	5	3 (60.0)	2 (40.0)	0 (0.0)
	Slovak Republic	5 AS	122	41 (33.6)	14 (11.5)	67 (54.9)
Southern Europe N=355	Cyprus	2 ED	39	6 (15.4)	33 (84.6)	0 (0.0)
	Greece	5 ED/1 <sup>b</sup>	206	130 (63.1)	72 (35.0)	4 (1.9)
	Spain	17 ED/6 AS	110	74 (67.3)	31 (28.2)	5 (4.5)
Northern Europe N=243	Finland	3 ED/4 AS	114	7 (6.1)	27 (23.7)	80 (70.2)
	Iceland	3 ED/2 AS	69	13 (18.8)	29 (42.0)	27 (39.1)
	Norway	4 ED/3 AS	48	5 (10.4)	24 (50.0)	19 (39.6)
	Sweden	3 ED	12	10 (83.3)	2 (16.7)	0 (0.0)
Other N=854	Chile	2 ED	39	22 (56.4)	9 (23.1)	8 (20.5)
	Israel	5 ED/4 AS	339	31 (9.1)	27 (8.0)	281 (82.9)
	Japan	45 ED/1 AS/1 <sup>b</sup>	339	246 (72.6)	67 (19.8)	26 (7.7)
	United States	6 ED/1 AS	137	81 (59.1)	35 (25.5)	21 (15.3)

Countries in Region 'Other' clustered for reasons of anonymity. 84 Nurse Assistants and ED technicians were included in the EMT group.

ED Emergency Department, AS Ambulance Service, EMT emergency medical technician (paramedic)

<sup>a</sup> medical professional organizations

<sup>b</sup> resuscitation training centre