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Clinical paper

When is a bystander not a bystander any more? A European survey



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Abstract

Objective: There is international variation in the rates of bystander cardiopulmonary resuscitation (CPR). 'Bystander CPR' is defined in the Utstein definitions, however, differences in interpretation may contribute to the variation reported. The aim of this cross-sectional survey was to understand how the term 'bystander CPR' is interpreted in Emergency Medical Service (EMS) across Europe, and to contribute to a better definition of 'bystander' for future reference.

Methods: During analysis of the EuReCa ONE study, uncertainty about the definition of a 'bystander' emerged. Sixty scenarios were developed, addressing the interpretation of 'bystander CPR'. An electronic version of the survey was sent to 27 EuReCa National Coordinators, who distributed it to EMS representatives in their countries. Results were descriptively analysed.

Results: 362 questionnaires were received from 23 countries. In scenarios where a layperson arrived on scene by chance and provided CPR, up to 95% of the participants agreed that 'bystander CPR' had been performed. In scenarios that included community response systems, firefighters and/or police personnel, the percentage of agreement that 'bystander CPR' had been performed ranged widely from 16% to 91%. Even in scenarios that explicitly matched examples provided in the Utstein template there was disagreement on the definition.

Conclusion: In this survey, the interpretation of 'bystander CPR' varied, particularly when community response systems including laypersons, firefighters, and/or police personnel were involved. It is suggested that the definition of 'bystander CPR' should be revised to reflect changes in treatment of OHCA, and that CPR before arrival of EMS is more accurately described.

Keywords: Out-of-hospital cardiac arrest, Bystander CPR, OHCA, EuReCa, Resuscitation registry, Resuscitation, Cardiac arrest

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Introduction

The reported rate of cardiopulmonary resuscitation (CPR) performed by bystanders ('bystander CPR') varies widely between and within European countries. Results from the EuReCa ONE study suggested that 'bystander CPR' rates varied from 6% to 78%.¹ 'Bystander CPR' is consistently shown to be positively associated with survival from out-of-hospital cardiac arrest (OHCA) where resuscitation is attempted,^{2–4} and is also associated with long-term survival and favourable neurological outcome.^{4–7} The term 'bystander CPR' is defined in the most recent Utstein publication, which presents the internationally recognised data set for OHCA data collection⁸:

"Bystander CPR is cardiopulmonary resuscitation performed by a person who is not responding as part of an organised emergency response system to a cardiac arrest. Physicians, nurses, and paramedics may be described as performing bystander CPR if they are not part of the emergency response system involved in the victim's resuscitation. Bystander CPR may be compression only or compression with ventilations."⁸

In most European OHCA data collection systems, reports of OHCA incidents are usually completed by local ambulance personnel during or immediately after the event, and data entry is not controlled by an independent observer. This means that the level of adherence to the Utstein definitions is not known. The aim of this cross-sectional survey was to improve our understanding of how the term 'bystander CPR' is interpreted in EMS systems across Europe, and to contribute to a better definition of 'bystander CPR' for future reference.

Methods

During the analysis of the EuReCa ONE study—a 1-month survey of OHCA incidence and outcome in 27 European countries¹—National Coordinators (NCs) attended a meeting in the Utstein Abbey in June 2017. Workshops were held to discuss the different configurations of OHCA response in EMS systems in participating countries. Following this meeting, an electronic questionnaire was developed, which included the Utstein definition of 'bystander CPR',⁸ and descriptions of the multiple scenarios discussed at the meeting. Standard questions were devised and were used for each scenario, with the aim of addressing the interpretation of 'bystander CPR' and the frequency of the scenario occurrence in individual EMS systems. The electronic survey was sent to all 27 NCs, who in turn distributed it to EMS personnel in their country, including those who had collected data for the EuReCa ONE study.

The questionnaire (see appendix in Supplementary material) comprised 60 different scenarios. The scenarios were identified during the workshops with EuReCa NCs at the meeting in Utstein Abbey in June 2017. They reflect the variations in EMS systems described by the workshop participants. For every scenario, survey respondents were asked to decide whether or not they believed 'bystander CPR' had been performed. For the purposes of analysis, results from the survey were categorised according to the percentage of agreement between respondents. For example, if all respondents agreed that a scenario described bystander CPR, this would have been considered perfect agreement. Similarly, if all respondents agreed that the scenario did NOT describe bystander CPR, this would also have been considered

perfect agreement. Scenarios where 90% or more of respondents agreed that 'bystander CPR' had been performed were considered to have good agreement. Scenarios where 70%–89% of respondents agreed were considered to have moderate agreement; between 55% and 69%—poor agreement; less than 55%—no agreement. This categorisation was agreed in consultation with the study statistician (RL) for the purposes of results interpretation. An agreement level of 90% has previously been described as being unlikely to be as a result of chance agreement.⁹ In order to ease interpretation, percentage agreement for each scenario was graphed, and colour coding was used to indicate the level of agreement for each scenario.

An electronic version of the questionnaire in the English language was administered using the Survey Monkey tool. Responses were extracted to Microsoft Excel and descriptively analysed. For each scenario the proportion of respondents who believed 'bystander CPR' had been administered was calculated, together with the 95% confidence interval, and results were tabulated. Results were also graphed so that groupings under each level of agreement could be visually represented.

Ethical approval for this study was granted by the Research Ethics Committee of the University of Luebeck (AZ 16-351).

Results

A total of 362 questionnaires were returned. Respondents were from 23 countries (Italy— $n = 115$, 32%; Germany— $n = 39$, 11%; Ireland— $n = 31$, 10%; other countries— $n = 171$, 47%). Due to the proportion of respondents from Italy, in order to avoid overrepresentation from one country, a random sample of 40 questionnaires from Italian respondents was drawn from the total sample, meaning the total number of questionnaires included in the analysis was 287.

The results of the analysis are presented in Fig. 1 and Table 1. As shown in Fig. 1, there was good agreement among respondents that 'bystander CPR' had been performed for scenarios where a layperson was on scene by chance, or when CPR was performed by a bystander who did not bring an AED to the scene. When the quality of CPR was in question or where CPR by a bystander had been interrupted and/or terminated, the proportion of respondents who considered this 'bystander CPR' decreased. There was a similar effect when on-duty police or healthcare personnel were on scene by chance. There was moderate agreement only that 'bystander CPR' had been performed for scenarios where physicians and fire fighters were on scene by chance, for scenarios where bystanders had ceased CPR early, or the CPR performed was perceived to be of low quality. Scenarios where cardiac arrest was not confirmed or where bystanders had successfully delivered an AED shock similarly achieved only moderate agreement that 'bystander CPR' had been performed. The proportion of agreement that 'bystander CPR' was performed was poor for scenarios where CPR was stopped before EMS arrival, or where CPR was performed without indication. There was no consensus on whether 'bystander CPR' had been performed in scenarios where on-duty police personnel were alerted to the scene, where a bystander performed ventilations only, or where an EMS Basic Life Support (BLS) unit was on scene by chance and performed CPR only.

In scenarios where a BLS or transporting unit—whether voluntary or EMS—was alerted to the scene, there was moderate agreement only that 'bystander CPR' had not been performed. Again, there was only moderate agreement that scenarios involving

Does this Scenario Describe Bystander CPR?

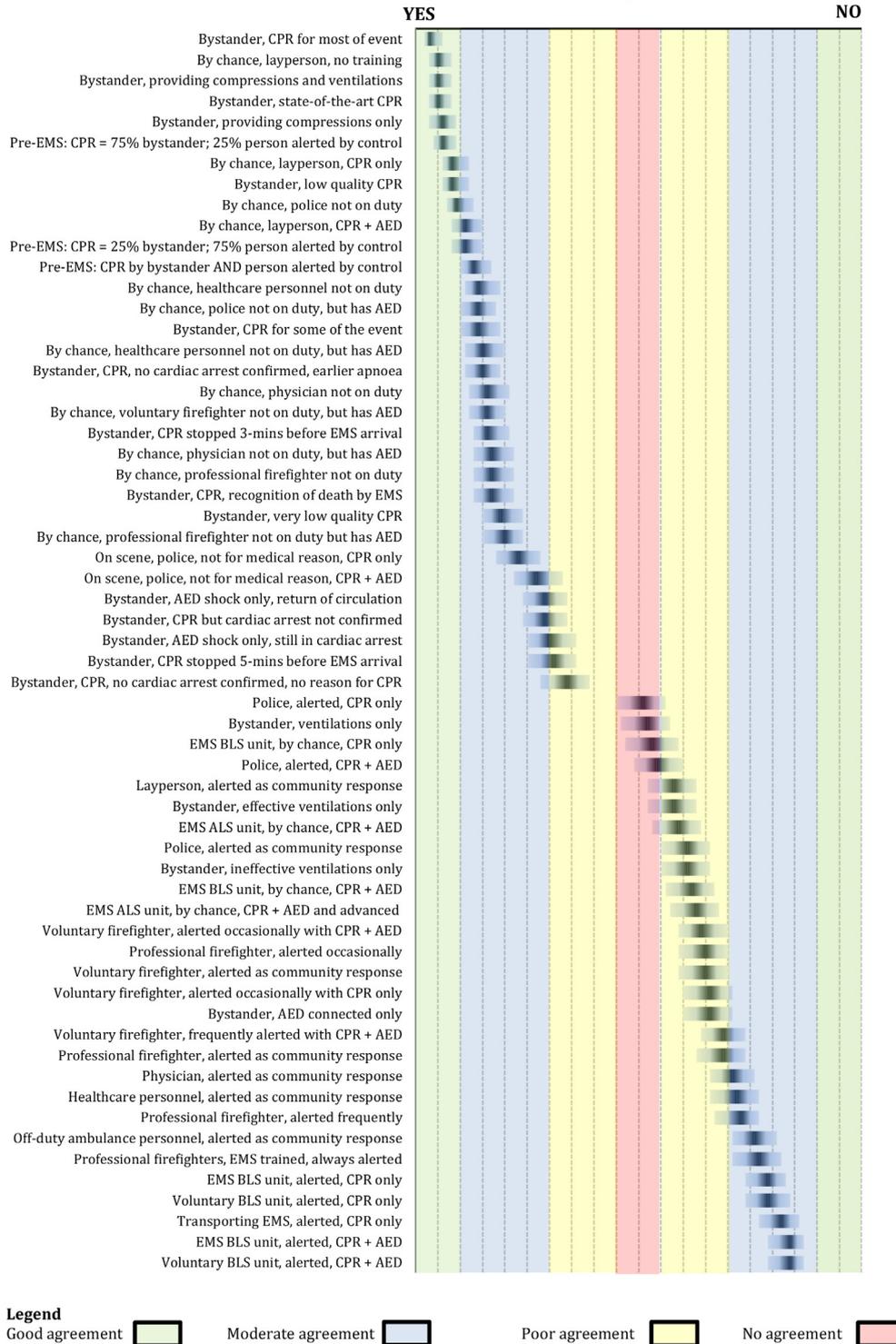


Fig. 1 – Level of agreement/disagreement to scenarios describing CPR before EMS arrival (95% CI). Good agreement: 90% or more; moderate agreement: 70%–89%; poor agreement: 55%–69%; no agreement: less than 55%.

firefighters trained to EMS level should not be documented as ‘bystander CPR’. In scenarios involving ambulance personnel, physicians, or healthcare personnel who were alerted to the scene while off-duty, as well as in scenarios including professional firefighters who were frequently alerted, there was moderate

agreement only that these types of scenarios did not describe ‘bystander CPR’. For most scenarios describing voluntary and professional firefighters who were alerted to the scene as part of a community response, there was poor agreement that these scenarios did not describe ‘bystander CPR’. Similarly, in scenarios

Table 1 – Level of agreement that scenarios describe bystander CPR presented as proportion with 95% CI.

Scenario	Is this bystander CPR? Proportion of agreement (%)	95% CI
By chance, layperson, no training	95	(92–97)
By chance, layperson, CPR only	92	(88–94)
By chance, layperson, CPR + AED	89	(85–92)
By chance, physician not on duty	84	(79–88)
By chance, physician not on duty, but has AED	83	(78–87)
By chance, healthcare personnel not on duty	86	(81–89)
By chance, healthcare personnel not on duty, but has AED	85	(80–89)
By chance, police not on duty	91	(87–93)
By chance, police not on duty, but has AED	86	(82–90)
By chance, professional firefighter not on duty	83	(78–87)
By chance, professional firefighter not on duty but has AED	80	(76–85)
By chance, voluntary firefighter not on duty, but has AED	84	(80–88)
On scene, police, not for medical reason, CPR only	77	(72–82)
On scene, police, not for medical reason, CPR + AED	73	(67–78)
Police, alerted, CPR only	49	(44–55)
Police, alerted, CPR + AED	46	(40–51)
Professional firefighter, alerted occasionally	35	(30–41)
Professional firefighter, alerted frequently	27	(23–33)
Professional firefighters, EMS trained, always alerted	23	(18–29)
Voluntary firefighter, alerted occasionally with CPR + AED	36	(30–41)
Voluntary firefighter, alerted occasionally with CPR only	34	(29–40)
Voluntary firefighter, frequently alerted with CPR + AED	31	(26–36)
Layperson, alerted as community response	42	(37–48)
Physician, alerted as community response	29	(24–34)
Off-duty ambulance personnel, alerted as community response	24	(19–29)
Healthcare personnel, alerted as community response	28	(23–34)
Police, alerted as community response	39	(34–45)
Professional firefighter, alerted as community response	31	(26–37)
Voluntary firefighter, alerted as community response	35	(30–41)
EMS BLS unit, by chance, CPR only	47	(41–53)
EMS BLS unit, by chance, CPR + AED	38	(33–44)
EMS BLS unit, alerted, CPR only	21	(17–26)
EMS BLS unit, alerted, CPR + AED	16	(13–21)
EMS ALS unit, by chance, CPR + AED	41	(36–47)
EMS ALS unit, by chance, CPR + AED and advanced	37	(32–43)
Transporting EMS, alerted, CPR only	18	(14–23)
Voluntary BLS unit, alerted, CPR only	21	(16–26)
Voluntary BLS unit, alerted, CPR + AED	16	(13–21)
Bystander, providing compressions only	94	(91–97)
Bystander, ventilations only	48	(43–54)
Bystander, providing compressions and ventilations	95	(92–97)
Bystander, AED shock only, still in cardiac arrest	70	(64–75)
Bystander, AED shock only, return of circulation	71	(66–76)
Bystander, AED connected only	34	(29–40)
Bystander, CPR for most of event	97	(94–98)
Bystander, CPR for some of the event	86	(81–90)
Bystander, CPR stopped 3-mins before EMS arrival	84	(79–87)
Bystander, CPR stopped 5-mins before EMS arrival	69	(64–75)
Bystander, state-of-the-art CPR	95	(92–97)
Bystander, low quality CPR	92	(88–94)
Bystander, very low quality CPR	81	(76–85)
Bystander, effective ventilations only	42	(37–48)
Bystander, ineffective ventilations only	39	(34–45)
Bystander, CPR but cardiac arrest not confirmed	71	(66–76)
Bystander, CPR, no cardiac arrest confirmed, earlier apnoea	85	(81–89)
Bystander, CPR, no cardiac arrest confirmed, no reason for CPR	66	(61–72)
Bystander, CPR, recognition of death by EMS	83	(78–87)
Pre-EMS: CPR = 75% bystander; 25% person alerted by control	94	(91–96)
Pre-EMS: CPR = 25% bystander; 75% person alerted by control	89	(85–92)
Pre-EMS: CPR by bystander AND person alerted by control	87	(83–90)

where laypeople and police personnel were alerted to the scene, there was poor agreement only that these scenarios did not describe 'bystander CPR'. There was also poor agreement that the presence of an EMS unit that had arrived on scene by chance was not 'bystander CPR', and poor agreement that a bystander performing effective ventilations only was not 'bystander CPR'.

Discussion

This cross-sectional survey shows very clearly and in detail for the first time that the term 'bystander CPR' is not uniformly interpreted by healthcare professionals dealing with OHCA, even in scenarios explicitly described in the Utstein definitions.⁸ Whereas standard situations (such as a layperson at scene by chance providing chest compressions) can easily be described as 'bystander CPR', the current Utstein-definition does not sufficiently acknowledge the different types and levels of non-ambulance responses that are becoming increasingly common across European EMS systems.

Early and effective CPR is vital in OHCA; however, the results of this study show large differences in the understanding of the term 'bystander CPR'. The methods to shorten the interval between cardiac arrest and the initiation of CPR have evolved rapidly in recent years.¹⁰ These measures include: introduction of dispatch-assisted CPR^{11,12}; more widespread basic life support (BLS) training in the community members^{13,14}; BLS training of school children^{15,16}; and alerted first responders.^{7,17} First responder systems may include official organisations such as police^{18,19} and firefighters,^{20,21} off-duty emergency or medical personnel, or laypeople dispatched by ambulance control to provide a first response to OHCA in partnership with their local ambulance service.²² Implementation of these different systems varies dramatically, even within one dispatch centre area. Additionally, the configuration of EMS systems varies from country to country, with some countries operating multi-tiered systems e.g. BLS units may be staffed with minimally trained rescuers who respond to cardiac arrest before staff trained in advanced life support arrive.

The results of our survey reflect the myriad responses to OHCA across Europe. In some situations, 'bystander CPR' is straightforward to classify, but in other situations, there is approximately a 50–50 chance of 'bystander CPR' being recorded as having been performed. The classic scenario of a single layperson starting CPR and handing over to the ambulance system is changing, in that a single patient may even be attended by multiple rescuers before arrival of an ambulance. For example, a layperson might start CPR as a result of dispatch-assisted instructions, a trained layperson close to the scene may be alerted to the scene by ambulance dispatch and take over the CPR. The alerted layperson might be replaced by a policeman, also alerted by ambulance dispatch, all of which may happen before the EMS arrives. This wealth of differently trained and differently alerted 'helpers' is difficult to categorise, and there is clearly a need to reconsider the definition of 'bystander CPR' to reflect the complexity of the modern response to OHCA in Europe.

Of particular note is the influence of mobile phone technology on the process of alerting 'helpers' to OHCA collapse. These apps have been shown to improve response intervals and survival when they are used as part of an organised response, both in urban and rural settings.^{23,24} There is increasing use of mobile apps to 'crowd source' trained lay responders in the event of OHCA, with notable examples of such an approach developing in Italy,²⁵ and in the cities of London,²⁶

Copenhagen,²⁷ and Singapore.²⁸ These examples show how the evolution of mobile technology is influencing the meaning of 'bystander CPR', and ways to reliably record and evaluate this type of 'bystander' intervention as part of systematic data collection are required.

There are some additional aspects that should be acknowledged as part of these considerations: firstly, the Utstein template is not translated into every European language. Additionally, in some languages, there is no equivalent term for 'bystander', and in translation "layperson" is used. Very few countries have a verified translation of the Utstein definitions, and this will influence local interpretation of the Utstein template. Variation in interpretation of the term 'bystander CPR' is also open to observer bias in that a subjective judgment as to whether 'bystander CPR' has been performed must be made by the ambulance personnel who file the data. The Utstein definition of 'bystander CPR' focuses on the rescuer who is there by chance, but several types of first responders and community response systems are becoming increasingly commonplace. A definition that reflects the different types of CPR response that might occur before ambulance arrival and which is understood by everybody who collects OHCA data, is important for high data quality in OHCA registries. For this reason, it is recommended that a definition is devised to describe rescuers who are not part of the ambulance system, but are alerted or dispatched to the scene.

For OHCA registries, and for studies investigating the effect of resuscitation by bystanders and first responders, commonly understood definitions are essential. When looking at research related to cardiac arrest of the last ten years it is not easy to understand how a bystander was defined, and if the participating parties had the same understanding. Our survey has highlighted the variation in interpretation of 'bystander CPR' across 27 European countries. Finding an agreed definition and similar interpretation is needed for meaningful comparisons of the impact of CPR between countries.

Based on the findings from our survey the following definition of 'bystander CPR' is suggested:

A person, irrespective of his/her medical, emergency or resuscitation qualifications, will be defined as providing 'bystander CPR' if:

- Any resuscitation has been delivered, that at least includes chest compressions or delivery of a defibrillation shock.
- The person who provided 'bystander CPR' must be present at the scene but must not have been alerted or directed to the scene by an ambulance dispatch centre.

Attachment of an AED only without delivery of a shock, or provision of ventilations only should not be classified as 'bystander CPR'.

Limitations

Firstly, this questionnaire was distributed via the NCs of the EuReCa ONE study to local contributors with a specific interest in and responsibility for OHCA management and data collection, and was not distributed widely to EMS personnel across Europe. While there is a risk of selection bias, it is assumed that the EMS population in general have similar, if not greater, difficulties when defining 'bystander CPR'.

Secondly, the sample size of our survey is not necessarily representative, and we did not collect any information on the characteristics of the survey respondents. Compared to the large number of EMS personnel dealing with OHCA in Europe, the

questionnaire was only distributed via the NCs of the EuReCa ONE study to a highly selective group of EMS personnel in their particular country. Since all respondents participated in the EuReCa ONE-study, they may have more data collection training and be more familiar with providing data about 'bystander CPR'. Additionally, some answers may reflect the opinion of a registry, and others the understanding of one individual professional.

In this study sample, the number of respondents per country is not in proportion to the population covered. This may result in an over- or underrepresentation of some countries. As almost one third of the returned questionnaires came from Italy, an attempt was made to adjust the results by drawing a random sample from Italian participants.

Thirdly, since all 60 questions provided in the survey were dealing with similar scenarios and the order of these questions in the questionnaire was not randomized, a learning effect in the course of responding to all scenarios cannot be excluded.

Finally, this survey may not have fully captured the complexity of different responses to OHCA across Europe. The scenarios used in the questionnaire were developed as a result of feedback from EuReCa ONE NCs only. Therefore there may be other scenarios that have not been considered in this survey.

Conclusion

Throughout Europe, there are substantial and important differences in the interpretation of 'bystander CPR' among EMS personnel. Our study highlights that the pre-EMS response to OHCA collapse has evolved since the last revision of the Utstein template, and suggests that the Utstein definition of 'bystander CPR' requires revision in order to reflect the variety of responses which result in the provision of CPR before EMS arrival.

Conflict of interest

Holger Maurer, Siobhán Masterson, Ingvild B. Tjelmeland, Rolf Lefering, Leo Bossaert, Johan Herlitz, Rudy W. Koster, Fernando Rosell-Ortiz and Jan Wnent have no conflict of interest to declare. Jan-Thorsten Gräsner is the project leader of the EuReCa project, PI for EuReCa ONE, EuReCa TWO, CEO of the German Resuscitation Registry. Bernd W. Böttiger is European Resuscitation Council (ERC) Board Director Science and Research; Chairman of the German Resuscitation Council (GRC); Member of the "Advanced Life Support (ALS) Task Force of the International Liaison Committee on Resuscitation (ILCOR)"; Member of the executive committee of the German Interdisciplinary Association for Intensive and Emergency Medicine (DIVI); Associated Editor of the European Journal of Anaesthesiology (EJA), Co-Editor of "Resuscitation"; Editor of the Journal "Notfall + Rettungsmedizin". He received professional fees for lectures from the following companies: Medupdate GmbH, "Forum für medizinische Fortbildung (FomF)", Baxalta Deutschland GmbH, Bayer Vital GmbH, ZOLL Medical Deutschland GmbH, C. R. Bard GmbH, GS Elektromedizinische Geräte G. Stemple GmbH. Gavin D. Perkins is an Editor for "Resuscitation".

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.resuscitation.2018.12.009>.

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