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Clinical paper

Assessing the weak links – Necessity and impact of regional cardiac arrest awareness campaigns for laypersons

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Abstract

Introduction: Public knowledge of out-of-hospital cardiac arrest (OHCA), and initiation of basic life support (BLS) is crucial to increase survival in OHCA.

Methods: The study analysed the knowledge and willingness to perform BLS of laypersons passing an AED at a public train station. Interviewees were recruited at two time points before and after a four year-long structured regional awareness campaign, which focused on *call*, *compress*, *shock* in a mid-size European city (270,000 inhabitants). Complete BLS was defined as multiple responses for *call for help*; *initiation of chest compressions*; and *usage of an AED,* without mentioning *recovery position*. Minimal BLS was defined as *call for help* and *initiation of chest compressions*.

Results: A total of 784 persons were interviewed, 257 at baseline and 527 post-campaign. Confronted with a fictional OHCA, at baseline 8.5% of the interviewees spontaneously mentioned actions for complete BLS and 17.9% post-campaign ($p = 0.009$). An even larger increase in knowledge was seen in minimal BLS (34.6% vs 60.6%, $p < 0.001$).

Conclusion: After a regional cardiac arrest awareness campaign, we found an increase in knowledge of BLS actions in the lay public. However, our investigation revealed severe gaps in BLS knowledge, possibly resulting in weak first links of the chain of survival.

Keywords: Out-of-hospital cardiac arrest, Public knowledge, Cardiac arrest awareness campaign, Health education

Introduction

With an annual incidence of 67 to 170 cases per 100,000 inhabitants,[1–3] out-of-hospital cardiac arrest (OHCA) is one of the leading causes of morbidity and death in industrialised nations.[4–5] Despite many efforts to improve survival after OHCA, survival rates remain low.[2–3]

Reduced time from collapse to initiation of cardiopulmonary resuscitation (CPR) is the essential and modifiable factor for survival of cardiac arrest.[6] This is also depicted in the first three links of the chain of survival, namely early recognition of cardiac arrest, initiation of early CPR, and early defibrillation.[7] This demonstrates the critical role of witnesses of cardiac arrests, as all of these actions can be performed by bystanders independently from medical personnel and double to triple survival rates.[8] Nevertheless, the rapid recognition of a cardiac arrest and the initiation of the necessary actions are challenging, especially in the emotionally demanding setting of an OHCA.

To improve bystander CPR rates, great efforts have been undertaken globally, nationally, regionally, and locally.[9–10] The most recent European Resuscitation Council (ERC) guidelines state within the top five messages of the 'Systems Saving Lives' chapter, that it is a primary recommendation to raise awareness about CPR and defib-

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rillation. To achieve this, it suggests training as many citizens as possible and to engage with *World Restart A Heart* initiatives.[7] Although the association of national initiatives to improve survival in cardiac arrest and improvement of bystander CPR rates have been shown previously,[11] the effect of smaller local or regional campaigns might be more subtle and difficult to reveal.

In spring 2014, we conducted interviews to assess knowledge gaps and attitudes regarding CPR in the general population of Graz, Austria, a mid-size European city with more than 270,000 inhabitants. Based on the preliminary results, we designed a regional cardiac arrest awareness campaign. In 2018, the interviews were repeated after four years of campaigning.

We report the results of laypersons as a pre-post study. We sought to assess the knowledge and willingness of the public to provide CPR over a specified lifespan.

Methods

A cross-sectional interview study was conducted at two time points at the main railway station of Graz, Austria. The interviews were held in a highly frequented place in visual range of a publicly accessible automated external defibrillator (AED), simulating a nearly ideal environment for a cardiac arrest scenario for lay rescuer involvement.

To allow the random selection of interviewees, all passers-by who crossed into a predefined area in front of the AED were asked to participate in an interview (Supplemental Fig. S1). This was done without indicating the interview's content. People known to the interviewers and incomplete interviews (e.g., prematurely terminated interviews) were excluded from the study. The study was approved by the local ethics committee of the Medical University of Graz (IRB 00002556; no 30-243 ex 17/18).

Study design

A previously published questionnaire by Schober et al.[12,] was modified and used to assess the knowledge and willingness of passers-by to proactively perform CPR, including use of an AED, in case of a witnessed cardiac arrest. The questionnaire was designed with open-ended questions, allowing for free answers, and was used in different populations.[12–13]

Displayed questions were read word by word and answers were directly entered into a tablet device and stored on a central server. The answers were collected by interviewers without commentary. Unexpected answers were entered as free text. To avoid priming interviewees to defibrillation, the questionnaire was designed by Schober et al. with two legs, creating two groups (group A and B). In the present study interviewees were assigned to group A and B in an alternating fashion (Fig. 1).

Group A was confronted with a fictional scenario of a collapsed person with suspected cardiac arrest and asked what actions should be taken as entry into the interview. While group B was made aware of the AED on the wall and asked what it would be used for as the first question. Subsequently, both groups were asked about their willingness to use an AED. The interview was concluded with questions regarding demography, previous CPR training and medical education (Supplemental Table S1).

After the first interview round in 2014, a regional cardiac arrest awareness campaign was designed and implemented. The campaign's focus was to provide clear and simple messages, summarised in the slogan "Cardiac Arrest. >call >compress >shock" (original German slogan: "Herzstillstand. >rufen >drücken >schocken"), combined with engaging brief and low-threshold CPR training sessions for the public. The campaign focused on delivering information regarding the most essential basic life support (BLS) actions: *call for help*, *provision of chest compressions* and *usage of an AED*. As trainers observed that introduction of an AED in brief training sessions caused distraction from continuous chest compressions, they focused on recognition of cardiac arrest, call for help and chest compressions, while information about AED usage was mentioned briefly.

The main campaign events were the *World Restart a Heart Days* with large scale sidewalk CPR training events. All training events were conducted in a 1:1 trainer-to-trainee ratio. By surveying volunteer trainers, participation in trainings of at least 1–2% of the city's population can be assumed. The practical campaign aspects were accompanied by billboard advertisement, distribution of pamphlets, social media presence and depiction by conventional media outlets, which further increased the campaigns reach.

In 2018, the second round of interviews was conducted to assess changes in knowledge and attitude after 4 years of campaigning. At time of publication, the campaign is still ongoing. More information about the current progress of the campaign can be found at https://www.drueckmich.at.

Endpoints

The primary endpoint of this study was the difference in the fraction of interviewed laypersons spontaneously mentioning correct and ***complete BLS*** actions when coming across an unresponsive person not breathing (Fig. 1: question A1) between 2014 and 2018. In accordance with the campaign's slogan, ***complete BLS*** actions were defined as mentioning all the following: *call for help*; *initiation of chest compressions*; and *defibrillation*. Ventilation was not considered mandatory. Combinations of answers that included *recovery position* were considered as incorrect CPR actions.

One secondary endpoint was the difference in the fraction of interviewed laypersons mentioning ***minimal BLS*** actions, defined as the combination of at least *call for help and initiation of chest compressions*, excluding *recovery position*.

Another secondary endpoint was the difference in the fraction of layperson interviewees likely to use an AED, according to Schober et al.,[12] assessed for groups A and B separately. ***Likely AED usage*** was assumed for group A, when the interviewee mentioned an AED as a possible action (question A1), knew what an AED is used for (question A2), knew AEDs are available in public places (question A3), and was willing to use them (question C2) in case of an OHCA. For group B ***likely AED usage*** was assumed if the interviewee correctly identified an AED (question B1), knew its purpose (question B2) and was willing to use it (question C2).

Statistics

In 2014, the first interview round was designed as a concept study. Therefore, no formal power analysis was performed.

In the second interview round, the focus was placed on spontaneously mentioned BLS actions (question A1). It was estimated that the proportion of people spontaneously mentioning ***complete BLS*** actions would increase by 10%. With a two-sided alpha of 0.05, and an intended power of 80%, a total number of 423 interviewees was required for group A.[14] The group allocation was set to a 3:1 ratio favouring group A, to ensure sufficient power for the primary endpoint requiring a minimum of 564 interviewees in total. A ran-

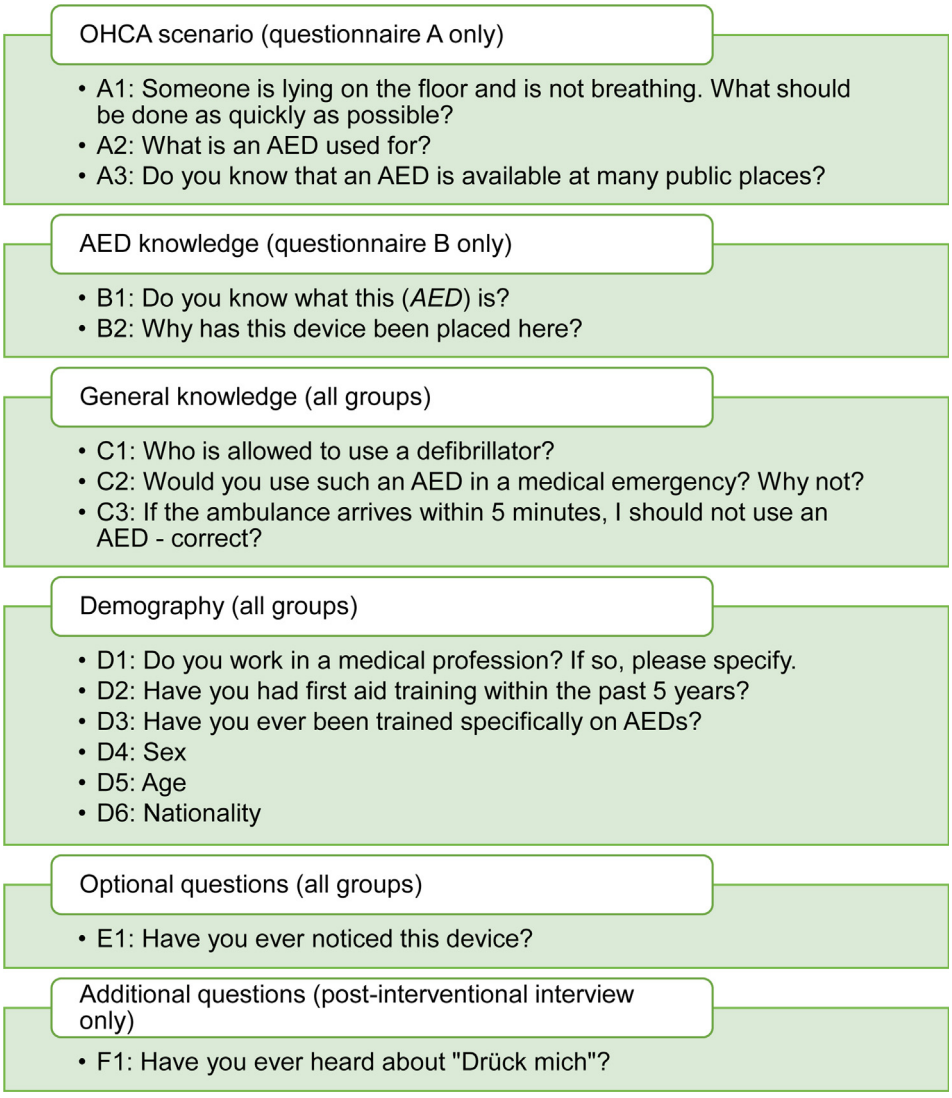

Fig. 1 – Summary of interview questions. Questions were adapted and translated from Schober et al.[12] Please see Supplemental Table S1 for questions and answers word-for-word.

domiser for clinical trials developed at the Medical University of Graz was used (https://www.randomiser.at) to assign interviewees to the groups A and B of the questionnaire. Medical personnel were excluded from the final analysis.

Statistics were performed using R 4.2.0 (The R Project, Vienna, Austria) and RStudio 2022.07.1 + 554 (RStudio PBC, Boston, MA). Fisher's exact test was used to compare the occurrence of the primary and secondary endpoints between interview rounds. All variables were expressed as median (interquartile range), mean (standard deviation) or proportion (95%-confidence interval using binominal testing), as appropriate.

Results

A total of 920 persons were interviewed. After exclusion of medical professionals, 784 remained for formal analysis, 257 at the baseline interview in 2014 and 527 in the post-campaign interview in 2018 (Fig. 2). All interviews were performed between 9:00 AM and 7:00 PM and most between Monday and Saturday (baseline 91.8%, post-campaign 94.4%, p = 0.163).

The median age was 28 years at both time points (IQR 19–57 at baseline and 20–52 post-campaign). Interviewees were female in 48.2% at baseline and in 51.0% post-campaign. Most interviewees were from Austria (93.0% at baseline and 92.6% post-campaign, Table 1).

A history of first aid training in the previous 5 years was similar at both timepoints (baseline 51.8% vs post-campaign 49.7%), but a higher proportion of interviewees reported AED training in the post-campaign interview (29.4% vs 39.3%, p < 0.008).

Primary endpoint

The primary endpoint ***complete BLS*** was reached in 8.5% of interviewees in the baseline interview and in 17.9% post-campaign. This increase was statistically significant (p = 0.009, Table 2, Graphical abstract).

Secondary endpoints

The secondary endpoint of ***minimal BLS*** was achieved by 34.6% of the interviewees in the baseline interview and 60.6% in the post-

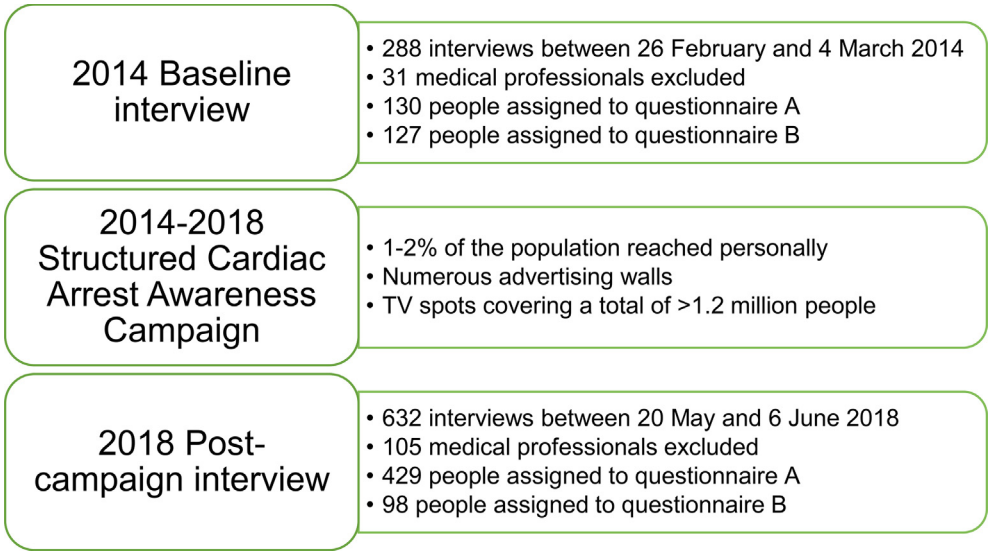

Fig. 2 – Study flowchart.

Table 1 – Interviewee baseline characteristics. AED: automated external defibrillator.

Parameter	Baseline interview (2014), n = 257	Post-campaign interview (2018), n = 527	P value
Age (years)	28 (19–57)	28 (20–52)	0.675
Female gender	48.2% (124/257) CI 42.0–54.5%	51.0% (269/527) CI 46.7–55.4%	0.494
Nationality			
Austria	93.0% (239/257) CI 89.2–95.8%	92.6% (487/526) CI 90.0–94.7%	0.885
Other European country	5.8% (15/257) CI 3.3–9.4%	5.9% (31/526) CI 4.0–8.3%	1.000
First aid training in the past 5 years	51.8% (180/255) CI 45.5–58.0%	49.7% (262/527) CI 45.4–54.1%	0.595
AED training	29.4% (75/255) CI 23.9–35.4%	39.3% (203/517) CI 35.0–43.6%	0.008
Weekday of interview			0.162
Sunday	8.2% (21/257) CI 5.1–12.2%	5.5% (29/527) CI 3.7–7.8%	
Other day	91.8% (236/257) CI 87.8–94.9%	94.5% (498/527) CI 92.2–96.3%	

Values are expressed as median (interquartile range) or proportion (count/total count), 95% confidence interval. * p < 0.05.

campaign interview. This is corresponding to an absolute increase of 26.0% (p < 0.001, Table 2) of interviewees spontaneously mentioning *call for help* and *initiation of chest compressions*, without *recovery position.*

Likely AED usage in group A significantly increased from 11.5% at baseline to 19.1% post-campaign (p = 0.048). In group B, ***likely AED usage*** was similar at both time points (27.6% vs 34.7%, p = 0.307).

The distinct actions mentioned when confronted with the fictional scenario of an OHCA are given in Table 2. Compared to the baseline interview, the spontaneous mentioning of *chest compression* increased by 19.6% post-campaign (53.8% in 2014 vs 73.4% in 2018, p < 0.001), while *recovery position* was mentioned less often (29.2% vs 16.6%, p = 0.002). There were no significant differences in the mention of *call for help, AED usage* and *ventilation*. All answers are summarized in Supplemental Table S2.

Recognition of the awareness campaign

Just 11.4% of participants recognized the name of the awareness campaign ("Drück Mich!"), while subsequently 27.0% of the interviewees sufficiently explained the purpose of the specific campaign.

Discussion

Our cross-sectional interview study showed a notable increase in knowledge of BLS actions in the general public following a regional cardiac arrest awareness campaign. However, overall low levels of knowledge at both interview time points and in particular staggeringly low levels of likely AED usage were observed.

In accordance with the campaign's slogan, "Cardiac Arrest. >call >compress >shock", we saw a doubling in our primary endpoint – complete BLS actions. This change was primarily due

Table 2 – Primary and secondary endpoints. The primary endpoint was defined as spontaneous mentioning of call for help, chest compressions and AED usage without mentioning of recovery position in group A. Minimal BLS actions were defined as mentioning of call for Help and chest compression without mentioning recovery position.

	Baseline interview (n = 257)	Post-campaign interview (n = 527)	P value
Primary endpoint			
Complete BLS actions (call for help + chest compressions + defibrillation without recovery position)	8.5% (11/130) CI 4.3–14.6%	17.9% (77/429) CI 14.4–21.9%	0.009
Secondary endpoints			
Minimal BLS actions (call for help + chest compressions and without recovery position)	34.6% (45/130) CI 26.5–43.5%	60.6% (260/429) CI 55.8–65.3%	<0.001*
Likely AED usage (group A)	11.5% (15/130) CI 6.6–18.3%	19.1% (82/429) CI 15.5–23.2%	0.048*
Likely AED usage (group B)	27.6% (35/127) CI 20.0–36.2%	34.7% (34/98) CI 25.4–45.0%	0.439
Individual answers (group A)			
Call for help	88.5% (115/130) CI 81.7–93.4%	91.6% (393/429) CI 88.6–94.1%	0.297
Chest compressions	53.8% (70/130) CI 44.9–62.6%	73.4% (315/429) CI 69–77.5%	<0.001*
Ventilation	43.8% (57/130) CI 35.2–52.8%	51.3% (220/429) CI 46.4–56.1%	0.161
Defibrillation	15.4% (20/130) CI 9.7–22.8%	21.7% (93/429) CI 17.9–25.9%	0.135
Recovery position	29.2% (38/130) CI 21.6–37.8%	16.6% (71/429) CI 13.2–20.4%	0.002*

AED: automated external defibrillator; BLS: basic life support. Values are expressed as proportion (count/total count), 95% confidence interval. * $p < 0.05$.

to the increase in spontaneous mentions of chest compressions and decrease in recovery position. Less than one fifth of all interviewees was able to name all required BLS actions. However, when defibrillation was not considered a mandatory element of BLS, the level and the increase of knowledge were markedly higher, as reflected by our secondary endpoint – minimal BLS. The larger increase in minimal BLS might have been influenced by the priorities of calling for help and chest compressions during campaign trainings. While we observed a high willingness to use an AED and the interviewees were able to identify the AED, the inability to recall the necessity of defibrillation combined with a lack of knowledge of the AED purpose culminated in low likely AED usage. The difference in likely AED usage between both groups can be explained by the fact that only group B was made aware of the close-by AED.

After four years, we found an increase in all single BLS actions (call for help, chest compressions, defibrillation, ventilation), while the only undesired action (recovery position) decreased. Although, the increase in knowledge is evident between the two interview rounds, this does not necessarily mean that these findings translate into an increase of actual bystander CPR – which should be the true endpoint of cardiac arrest awareness campaigns. While survival might be a desirable outcome it is hard to detect,[15] the discrepancy between willingness and actual provision of bystander CPR was observed in South Korea.[16] The introduction of CPR policies led to increased willingness to perform CPR without change in actual bystander CPR rate. However, other publications reported an association between CPR training, actual bystander CPR rates, and outcomes.[17–18]

Multiple studies have investigated intervention bundles to increase CPR before emergency medical service arrival, targeting lay bystanders as well as organized first responders.[19–22] However, we focused singularly on lay bystanders.

The broad spectrum of approaches and methods to improve awareness of cardiac arrest can be illustrated by the diversity of campaigns that were performed in recent years,[23–28] focussing on public spaces,[23] neighbourhoods with low education,[24] and were disseminated by local community members[26] or mass media.[27] In our cardiac arrest awareness campaign, highly motivated medical students were involved as trainers, similar to Hooker et al.[25] There are only a few studies available examining the effect of cardiac arrest awareness campaigns,[23–24,27] mostly evaluating the immediate effect on BLS knowledge,[23–24] while Nielsen et al. found increased knowledge and willingness to perform BLS after a mass media campaign.[27]

It would be desirable to have a uniform, standardised tool to evaluate cardiac arrest awareness campaigns, as they can be considered as medical interventions and should be evaluated as such. This would generate comparability between different strategies and provide a reliable basis to inform public health authorities. Additionally, a standardised tool could support decision making for resource allocation to strategically strengthen the individual links of the chain of survival. The questionnaire by Schober et al. is a valuable tool to assess the public's knowledge of, and attitude towards proactive CPR measures.[12] A strength of such on-site interviews[12–13,29–31] is that they inhibit potential preparation by interviewees by design, compared to web-based approaches.[32–34] As the questionnaire by Schober et al. has already been used in multiple investigations,[12–13] direct comparison can be drawn between the studies. While mentions of complete BLS actions were alarmingly low in our baseline interview, individual BLS actions were mentioned more frequently compared to preceding studies from Amsterdam (the Netherlands) in 2009[12] and Philadelphia (PA, USA) in 2013.[13] This might indicate a general trend in knowledge over time or highlight that local variations exist.

In Austria, considerable efforts have been undertaken to enable public access defibrillation.[35] However, we observed overall a low likely AED usage. The question remains how resources have to be invested to close this gap, or if the limited resources should be spent to promote simpler CPR actions more broadly.

In 2014, we had to address low knowledge regarding chest compressions and a general misconception of recovery position, we might be ready to focus more on defibrillation in the future. Nevertheless, early defibrillation is a complex task for bystanders, with several subtasks and logistic challenges as described above. In the light of this, it should be discussed whether early defibrillation should be promoted to the general public by broad awareness campaigns or if targeted approaches can achieve early defibrillation more efficiently. As such, cardiac awareness campaigns may focus on reaching as many people as possible to improve recognition of cardiac arrest and initiation of chest compressions by bystanders, who are assisted by dispatchers.[36] While dispatched AEDs through citizen first responders and police officers may be a more effective strategy to facilitate early defibrillation.[7,37] Tiered systems like this may resemble an actionable concept to make early high-quality resuscitation available to all.

Limitations

Our findings cannot be singularly attributed to our regional cardiac arrest awareness campaign, as reflected by the low rate of recognition of the campaign's name. However, the focus of the campaign was not to establish a brand but deliver the core message of ">call >compress >shock". Many efforts have been undertaken on several levels and by varying institutional bodies. Initiatives like the *World RestartaHeart Day*[38] transport a central message globally which overlaps and amplifies the local efforts. This becomes evident in the large media attention regarding cardiac arrest, which in return may have contributed to the knowledge gain in the public.[39]

The entry point into the questionnaire is a fictional scenario already identified as cardiac arrest, as such recognition of cardiac arrest was not studied although it was an objective of the campaign.

The study setting and design might have introduced a selection bias, as people willing to be interviewed could have been more open to participate in prior awareness campaign events as well. This study cannot be interpreted as a representative cross-sectional analysis of the whole population, due to the setting at a public train station. However, it can be considered representative of the city's train commuters, who may have a higher probability to observe an OHCA compared to the average population. As a non-randomized study, it cannot establish causality between the cardiac arrest awareness campaign and changes in knowledge of BLS actions. Lastly, as the study has been performed before the COVID-19 pandemic, its global impact on the public's willingness to perform BLS cannot be estimated by this analysis.

Conclusions

We found an increase in knowledge of BLS actions in the public after four years of cardiac arrest awareness campaigning. However, the overall knowledge regarding BLS actions remained low. Our study should encourage the evaluation and critical reflection of cardiac arrest awareness campaigns and their objectives. The implementation of standardised evaluation tools might help to strengthen the individual links of the chain of survival and allow to improve the systems that save lives.

Conflicts of Interest

DZ received speaker honoraria from Daiichi Sanchyo, travel grants from Daiichi Sankyo, Pfizer, and research grants from Boston Scientific. MM received research grants from Biosense Webster, Abbott, Biotronik, Zoll, Boston Scientific, Daiichi Sankyo, Bayer; speaker honoraria from Bayer, Biotronik, Amomed, AOP Orphan, Boston Scientific, Daiichi Sankyo, BMS/Pfizer. DS received speaker honoraria from Zoll Medical.

All other authors have nothing to disclose.

CRediT authorship contribution statement

Simon Orlob: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administration. **Stephan Grundner:** Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – review & editing. **Johannes Wittig:** Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization. **Michael Eichinger:** Conceptualization, Investigation, Data curation, Writing – review & editing. **Felix Pucher:** Conceptualization, Investigation, Data curation, Writing – review & editing. **Michael Eichlseder:** Conceptualization, Investigation, Data curation, Writing – review & editing. **Raphaela Lingitz:** Conceptualization, Investigation, Writing – review & editing. **Martin Rief:** Conceptualization, Investigation, Writing – review & editing. **Niklas Palt:** Conceptualization, Investigation, Writing – review & editing. **Charlotte Hartwig:** Conceptualization, Investigation, Writing – review & editing. **Gregor Zangl:** Conceptualization, Investigation, Writing – review & editing. **Markus Haar:** Conceptualization, Investigation, Writing – review & editing. **Martin Manninger:** Investigation, Writing – review & editing. **Ursula Rohrer:** Investigation, Writing – review & editing. **Daniel Scherr:** Investigation, Writing – review & editing. **Andreas Zirlik:** Investigation, Writing – review & editing. **Gerhard Prause:** Conceptualization, Investigation, Writing – original draft, Writing – review & editing, Supervision. **David Zweiker:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.resplu.2022.100352.

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