

## **Cardiopulmonary resuscitation training to improve out-of-hospital cardiac arrest survival – addressing potential health inequalities**

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The importance of early delivery of high-quality cardiopulmonary resuscitation (CPR) and rapid defibrillation to achieve swift and sustained return of spontaneous circulation (ROSC) and improve out-of-hospital cardiac arrest (OHCA) survival has been highlighted again following the recent successful resuscitation of Christian Eriksen, during a live international football match. Overall, however only about 1 in 10 people experiencing an OHCA will be alive at 30-days following such an event.<sup>1</sup> To improve ROSC and survival, much more needs to be done, particularly in the initial links of the chain of survival,<sup>2</sup> to ensure widespread CPR training and early defibrillator access, which has been proven to improve outcomes.<sup>3</sup> There are good examples of national and international efforts such as in Norway, where CPR training has been part of the school's national curriculum since 1961 and the World Restart a Heart initiative.<sup>4</sup> Given that this lifesaving intervention was witnessed live on television by millions across the world, along with publicised successful outcome, there is now a favourable moment to take further action and address any health inequalities that may exist.<sup>5-</sup>

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There have been concerted efforts to increase training and resources for the public in many countries.<sup>8</sup> Resuscitation Council UK for example, offers freely available material on their websites, including an online course and 'Lifesaver' interactive game to help members of the public to learn the theory and feel more comfortable towards delivering CPR.<sup>9</sup> The practical aspect of CPR delivery and early use of an automated electrical defibrillator (AED) should also be taught and assessed to ensure that effective resuscitation is delivered in the heat of cardiac arrest situation, without delay. In person courses are available but often come at a cost. Several other efforts are also underway to try and improve mapping of AEDs,<sup>10</sup> apps to alert the medical services and off-duty qualified professionals who may be in the vicinity of the cardiac arrest (e.g., GoodSAM and Hearrunner).<sup>11,12</sup> Potential barriers to AED use

include cost effectiveness, coordinated mapping and registration of AEDs, easy access to all when required, and variable legislations within and between countries.<sup>13</sup>

Efforts are needed to further implement scientific proven methods alerting citizen responder program using smart phone technologies in order to improved bystander CPR and defibrillation.<sup>14,15</sup> In particular, potential health inequalities in the delivery of CPR and training the public need to be addressed. OHCA has disproportionately lower CPR delivery rates and subsequent survival for those in areas of socioeconomic deprivation and those that make up minority ethnic groups.<sup>6,7</sup> When developing and delivering training, equitable opportunities need to be prioritised.

Alongside wider teaching and dissemination of lifesaving skills, increasing public awareness of ways to prevent cardiovascular disease and premature cardiac arrest should be offered. During the lockdown due to recent COVID-19 pandemic peaks, people were more likely to be performing CPR on family or friends whilst at home,<sup>16</sup> hence there is a personal incentive. The importance of learning CPR can also be promoted from a humanitarian and religious perspective with many scriptures teaching that to save one life is akin to saving the whole of mankind.<sup>17</sup>

### **Coordinated and increased opportunities for the public**

A variety of approaches to provide opportunities to train the public, including in-person and virtual exist. These should be considered in a national, coordinated strategy, allowing a wider reach, and limiting potential health inequalities (Figure 1).

1. Training CPR through sports clubs, including football associations, and sports cardiology centres. Short animations or videos could be aired at the start of a football matches.

Highlighting and mapping of the locations of AEDs, including in the stadium would also alert the public to their function. This could then be supplemented by the offer of training at football grounds on non-match days.

2. Offer CPR training through religious institutions – the British Islamic Medical Association (BIMA) Lifesavers programme is an example of a national, coordinated training day delivered through mosques, with the option of teaching in different languages if needed, and delivered virtually during the pandemic restrictions of 2020.<sup>18</sup> Similar training could be offered through churches, temples, and other community centres to engage communities that may otherwise be hard to reach.

3. The UK will be embedding CPR training into the national curriculum for secondary schools from 2022, following the strategy adopted by Norway and others. School teachers should be supported to feel confident to deliver the training that will be required from them and be able to assess CPR quality and can be delivered using a ‘teach the teachers’ model.

4. Some countries, such as Switzerland, require that people take first aid/CPR training as an integral part of obtaining a driving licence, mandated by the government. This could be adopted by other countries to ensure wider reach to the adult population.

5. The ability to deliver training and at minimal or no cost to the public would allow those more people and particularly those that may be socioeconomically disadvantaged and be a mean of helping to reduce health inequalities, something that the COVID pandemic has

highlighted. Virtual delivery of such live courses may be one mechanism that could be explored. Signposting to freely available material online may improve uptake.

6. Wider coordination of national or regional training through national resuscitation councils, charities, health systems, ambulance services and cardiovascular societies can help raise awareness and uptake. Although this is occurring in many countries, there is still room for improvement.<sup>4,19</sup>

7. Local public champions or celebrities,<sup>20</sup> particularly those who may have survived an OHCA or family members who have lost a loved one following a cardiac arrest can help to advocate and encourage other members of the public.

Recent events have again highlighted the importance of effective CPR. Healthcare professionals and policy makers should take advantage of this opportunity to engage an interested public and offering wider training to allow the public to deliver early CPR and defibrillation towards improving cardiac arrest survival. Potential health inequalities in CPR training, delivery and AED access should be highlighted and effectively addressed.

**Conflicts of interest**

None declared

**Authors' contributions**

MYK conceptualised the idea and wrote the original draft. CAAC, FR, MWA, and RP critically revised the manuscript. All authors gave final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy."

## References

- 1 Riva G, Ringh M, Jonsson M, *et al.* Survival in Out-of-Hospital Cardiac Arrest after Standard Cardiopulmonary Resuscitation or Chest Compressions only before Arrival of Emergency Medical Services: Nationwide Study during Three Guideline Periods. *Circulation* 2019; **139**: 2600–9.
- 2 Deakin CD. The chain of survival: Not all links are equal. *Resuscitation* 2018; **126**: 80–2.
- 3 Hasselqvist-Ax I, Riva G, Herlitz J, *et al.* Early Cardiopulmonary Resuscitation in Out-of-Hospital Cardiac Arrest. *N Engl J Med* 2015; **372**: 2307–15.
- 4 Böttiger BW, Lockey A. World Restart a Heart initiative: all citizens of the world can save a life. *Lancet*. 2018; **392**: 1305.
- 5 Schattenkerk J, Kucera K, Peterson DF, Huggins RA, Drezner JA. Socioeconomic factors and outcomes from exercise-related sudden cardiac arrest in high school student-athletes in the USA. *Br J Sports Med* 2021; **0**: bjsports-2021-104486.
- 6 Brown TP, Booth S, Hawkes CA, *et al.* Characteristics of neighbourhoods with high incidence of out-of-hospital cardiac arrest and low bystander cardiopulmonary resuscitation rates in England. *Eur Hear J - Qual Care Clin Outcomes* 2019; **5**: 51–62.
- 7 Kjærulff TM, Bihrmann K, Zhao J, *et al.* Acute myocardial infarction: Does survival depend on geographical location and social background? *Eur J Prev Cardiol* 2019; **26**: 1828–39.
- 8 Perkins GD, Gräsner J-T, Semeraro F, *et al.* European Resuscitation Council Guidelines 2021: Executive summary. 2021. DOI:10.1016/j.resuscitation.2021.02.003.
- 9 Home | Resuscitation Council UK. <https://www.resus.org.uk/> (accessed May 22, 2021).
- 10 British Heart Foundation. The Circuit - The National Defibrillator Network.

- <https://www.thecircuit.uk/> (accessed Oct 17, 2021).
- 11 GoodSAM. <https://www.goodsamapp.org/> (accessed June 19, 2021).
- 12 Hearrunner. <https://hearrunner.com/> (accessed Nov 28, 2021).
- 13 Sherrid M V., Aagaard P, Serrato S, *et al.* State Requirements for Automated External Defibrillators in American Schools: Framing the Debate About Legislative Action. *J. Am. Coll. Cardiol.* 2017; **69**: 1735–43.
- 14 Ringh M, Rosenqvist M, Hollenberg J, *et al.* Mobile-Phone Dispatch of Laypersons for CPR in Out-of-Hospital Cardiac Arrest. *N Engl J Med* 2015; **372**: 2316–25.
- 15 Andelius L, Malta Hansen C, Lippert FK, *et al.* Smartphone Activation of Citizen Responders to Facilitate Defibrillation in Out-of-Hospital Cardiac Arrest. *J Am Coll Cardiol* 2020; **76**: 43–53.
- 16 Marijon E, Karam N, Jost D, *et al.* Out-of-hospital cardiac arrest during the COVID-19 pandemic in Paris, France: a population-based, observational study. *Lancet Public Heal* 2020; **5**: e437–43.
- 17 Surah Al-Ma'idah - 32 | Quran.com.  
<https://quran.com/5/32?translations=84,85,18,101,20,19,17,22,21,95> (accessed June 19, 2021).
- 18 Khanji MY, Ali B, Ahmed S. Virtual delivery of cardiopulmonary resuscitation training for the public: how to make it work. *Eur Heart J* 2021; published online Sept 13. DOI:10.1093/eurheartj/ehab652.
- 19 Restart A Heart Day | Resuscitation Council UK. <https://www.resus.org.uk/get-involved/restart-heart-day> (accessed June 19, 2021).
- 20 Vinnie Jones teams up with BHF on campaign to urge people to learn CPR.  
<https://www.bhf.org.uk/what-we-do/news-from-the-bhf/news-archive/2021/june/vinnie-jones-teams-up-encourage-everyone-learn-cpr> (accessed Aug



7, 2021).

## **Figure legend**

Figure 1. Strengthening the chain of survival through coordinated efforts for delivery of CPR training to the public. Adapted from Deakin 2018.<sup>2</sup>