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EDITORIAL

BIG FIVE strategies for survival following out-of-hospital cardiac arrest

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Sudden cardiac arrest (SCA) in the out-of-hospital setting is the third leading cause of death in industrialised nations, and facts suggest that many of these deaths are potentially avoidable. In Europe and the USA alone, 700 000 people die each year due to SCA despite the fact that emergency medical services (EMS) initiate cardiopulmonary resuscitation (CPR).[1,2] The same applies to most other parts of the world. Thus, SCA is currently one of the most important healthcare issues, not only because of the opportunities to avoid many of these premature deaths but also because of the huge implications for patients, relatives, healthcare systems and national economies.[3]

International consensus on our current CPR concepts, procedures and techniques is very well developed following many years of experimental and clinical research. A systematic review of randomised controlled trials has concluded, however, that overall survival has not improved despite 3 decades of initiatives. Several recent large-scale multicentre trials have failed to show further marked improvements in SCA survival with drugs,[5–7] airway management techniques and devices,[8–10] and other technical CPR equipment.[11–13] It is currently not anticipated that the international guidelines and recommendations on CPR will come up with any new or 'magic' CPR strategy, drug or device to further increase survival in the near future.

In contrast, several large-scale studies have shown that it is relatively easy and extremely cost-effective to increase the number of survivors with good neurological outcome following SCA, not with drugs and devices, but with robust data on cardiac arrest incidence and survival, political interventions and conceptual system changes aimed at strengthening each ring of the 'chain of survival'.[14–16] These studies have focused on cultural changes and nationwide campaigns and interventions, which we have summarised as the 'BIG FIVE strategies for survival following SCA. With international implementation of these 'BIG FIVE for survival', we believe that it is possible to save several hundreds of thousands of lives after SCA every year worldwide. The 'BIG FIVE strategies for survival' following SCA are detailed below and depicted in Fig. 1.

(1) Community programmes to increase bystander CPR. Local, national and international campaigns to increase lay CPR rates (KIDS SAVE LIVES/schoolchildren education in resuscitation,[14,17–19] 'World Restart a Heart (WRAH)' initiative,[2,20] short CPR courses for adults, media and press campaigns, etc.).[14] Because the brain can normally survive only for 3 to 5 min without any damage, and EMS often arrive later, one major focus to increase survival is the instigation of bystander CPR. This 'bridging' of the victim by bystander intervention until EMS arrival will slow down the clock of cerebral hypoxia and preserve the brain in this 'time window for lay resuscitation'.[14,17,21,22] In a minority of countries, bystander CPR rates are above 60%. In most countries worldwide, however, bystander CPR rates are below 20 or 30%.[14,23] It has been shown that bystander CPR is significantly associated with higher survival rates, improved neurological outcome, better quality of life and an increase in return-to-work for SCA patients.[14,15] This has been demonstrated in

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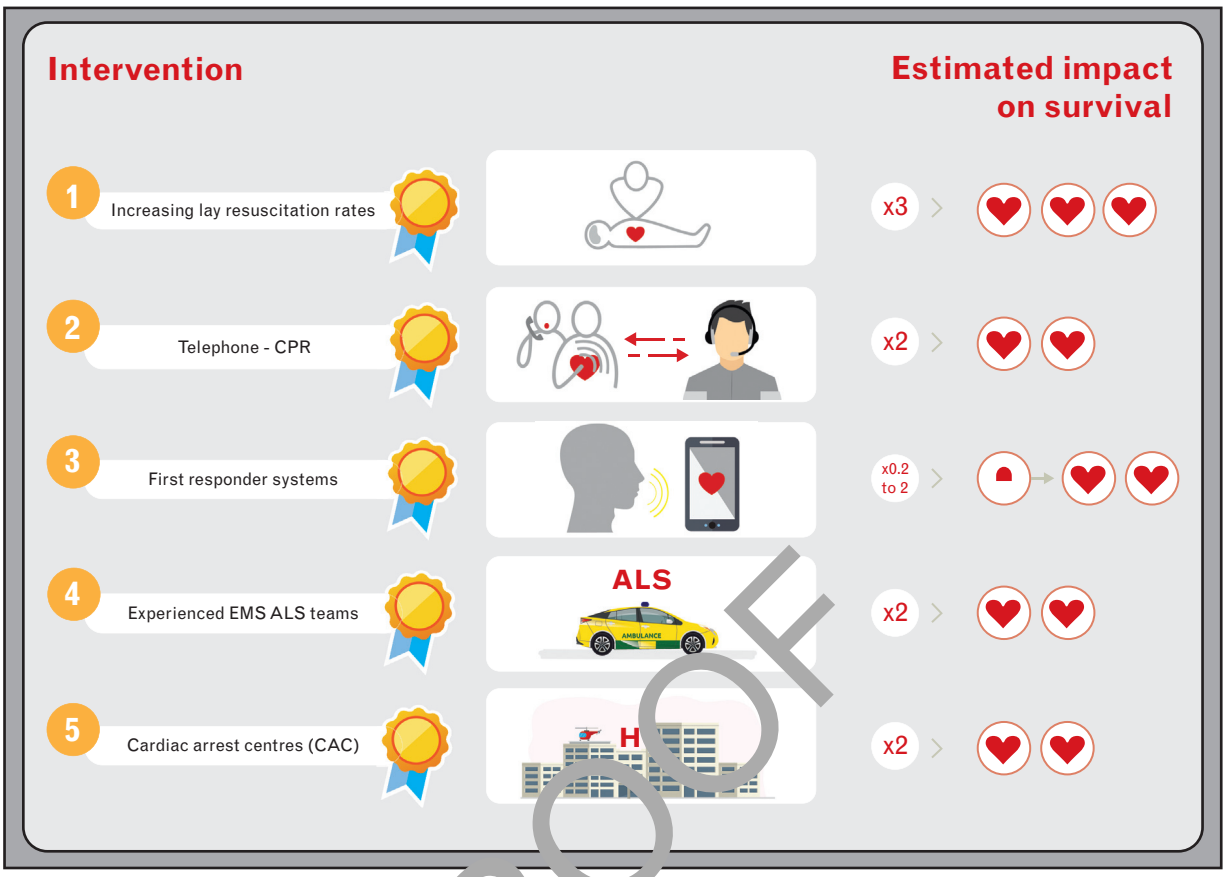
Fig. 1



The 'BIG FIVE for survival' and their potential impact on survival following out-of-hospital cardiac arrest. ALS, advanced life support; CAC, cardiac arrest centres; CPR, cardiopulmonary resuscitation; EMS, emergency medical services.

Denmark where, over a period of 9 years, a national campaign has increased bystander CPR rates from around 20 to 45%. This was associated with a three-fold increase in survival and better neurological outcome following out-of-hospital cardiac arrest.[14,15] Thus, increasing bystander CPR rates from lower levels to 50% and more is associated with a three-fold increase in survival following SCA.

*(2) **Dispatcher-assisted or telephone CPR.***

In most emergency calls, the caller does not recognise that the victim is in cardiac arrest and does not start CPR spontaneously. Therefore, prompt recognition of cardiac arrest by the dispatcher who can then motivate the caller to start CPR is important.[24] It has been demonstrated clearly that instructions for chest compressions given by the dispatcher via phone are feasible and most effective. Telephone CPR may be combined with support from specific protocols, computer applications and techniques that allow the dispatcher to receive more information from the scene and the victim. The number needed to treat for telephone CPR has been calculated to be around seven.[24,25] Therefore, telephone CPR is associated with an up to two-fold increase in survival following SCA.[24]

*(3) **First responder programmes to start CPR and use public access defibrillators.***

Trained and/or untrained persons and independent medical personnel from nearby can be alerted in the case of SCA by the dispatch centre in parallel with the EMS.[26–28] Several studies have shown a significant increase in the rate of CPR provided before EMS arrival and a potential increase in overall survival (OS).[26,29] Early defibrillation using public access defibrillators delivered by lay or professional first responders has been shown to correlate with increased survival after out-of-hospital cardiac arrest, with reported median survival rates by lay responders of 53% (range 26 to 72) in one systematic review.[30] First responders have a high potential and are particularly helpful when bystander CPR rates are low and/or response times for EMS are long. According to the available studies, implementation of first responder programmes can thus be associated with an estimated

0.2 to 2-fold increase in survival, depending on and determined by the underlying culture and system characteristics.

(4) High-quality CPR.
Taking care of SCA patients by an EMS staffed with well-trained advanced life support paramedics and physicians in the out-of-hospital setting is associated with a two-fold increase in short-term and long-term survival.[31,32] This has been demonstrated in several single and multicentre trials, comparisons and meta-analyses all around the world.[31,32] Few other system configurations with high density levels of first responders and extremely short response times have achieved similar levels of outcomes worldwide.[31,32]

(5) Specialised postresuscitation care.
In 60 to 80% of all SCA patients, acute coronary syndrome and/or acute myocardial infarction are the underlying causes of deterioration.[33,34] All registry data and several prospective studies have demonstrated that treating the underlying cause of SCA by immediate acute percutaneous coronary intervention (PCI) within 60 or 90 min in a specialised cardiac arrest centre with 24/7 PCI availability is associated with a doubling in survival.[35–39] SCA patients with coronary problems may need PCI at least as fast as patients with acute coronary syndrome and without cardiac arrest or shock. Even transport of SCA patients with ongoing CPR to a PCI facility with subsequent intervention may be associated with good outcomes.[38] Extracorporeal membrane oxygenation with transporting devices and subsequent PCI can also be indicated in selected patients but outcome data are missing.[40] Adequate temperature management, optimised haemodynamic and ventilatory support, prognostication and other individualised interventions in specific circumstances, such as treatment of tension pneumothorax in traumatic cardiac arrest and specific interventions in patients suffering from acute pulmonary embolism etc., are further important quality and outcome indicators of specialised centres.[41] Thus, ultrafast and straightforward management of SCA patients in specifically staffed and equipped hospitals, so-called cardiac arrest centres, seems to further improve survival by around two-fold.[38,41]

Successful treatment of SCA patients to increase survival rates and neurological recovery has definitely moved the focus to the out-of-hospital setting, as by far the biggest impact on the chain of survival is within the first links. Implementing the BIG FIVE will, with current evidence, markedly improve the outcome of SCA patients worldwide.

Moreover, public awareness, motivating, educating and involving lay people – and school children in particular – has a major social impact, promotes empathy and is establishing a general culture of assisting the community.

A critical foundation for all these life-saving strategies is for regions and nations to create a robust cardiac arrest strategy and a registry or database that allows accurate determination of cardiac arrest incidence and survival rates.[4–16,23] National cardiac arrest registries promote continuous quality improvement efforts, allow for identification of areas of strengths and weaknesses in the chain of survival, promote public health initiatives and will allow for identification of future opportunities. Nations with robust cardiac arrest data often enjoy significantly improved survival rates over relatively short periods of time.[14–16,23] The experiences from Denmark and elsewhere around the world[2,14–16] can and should serve as a blueprint to increase survival following SCA in all countries. Worldwide, we propose that these 'BIG FIVE for survival' strategies are the most important impact factors for increasing overall survival with good neurological recovery after SCA as well as improving the overall national health and global economics in industrialised countries.

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