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Resuscitation on the field of play: a best-practice guideline from Resuscitation Council UK

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ABSTRACT

Sudden cardiac arrest (SCA) is the leading cause of sudden death in athletes during high-level, organised sport. Patient-related and event-related factors provide an opportunity for rapid intervention and the potential for high survival rates. The aim of this consensus was to develop a best-practice guideline for dedicated field-of-play medical teams responding to SCA during an organised sporting event. A task-and-finish group from Resuscitation Council UK identified a stakeholder group of relevant experts and cardiac arrest survivors in March and April 2022. Together, they developed a best-practice guideline using the best available evidence. A public consultation period further refined the guideline before it was finalised in December 2023. Any sudden collapse, without rapid recovery during sporting activity, should be considered an SCA until proven otherwise. Field-of-play medical teams should be empowered to access the collapsed athlete as soon as possible and perform initial essential interventions in situ. This includes a suggested minimum of three cycles of cardiopulmonary resuscitation and defibrillation in persistent shockable rhythms while other aspects of advanced life support are initiated. There should be careful organisation and practice of the medical response, including plans to transport athletes to dedicated facilities for definitive medical care. This best-practice guideline complements, rather than supersedes, existing resuscitation guidelines. It provides a clear approach to how to best treat an athlete with SCA and how to organise the medical response so treatments are delivered effectively and optimise outcomes.

INTRODUCTION

Sudden cardiac arrest (SCA) during sporting activity is an infrequent but devastating event. Exercise is protective of health in general, but the risk of sudden collapse and death during and immediately after exercise is higher than during inactivity.¹ One estimate suggests that around 1 in 217 000 people per year in the general population have a sports-related sudden death, with only 6% of these occurring in 'young competitive athletes' (aged 10–35 years).² The best estimate for athletes up to 40 years old participating in organised sport is that between 1 in 40 000 and 1 in 80 000 have a sudden cardiac death each year (at any time, not just during exercise),³ with higher risks in certain groups (eg, men, African-American athletes) and sports (eg,

KEY POINTS

- ⇒ Any unexpected collapse in an athlete without rapid recovery on the field of play should be presumed to be sudden cardiac arrest (SCA) until proven otherwise.
- ⇒ Agonal breathing and seizure-like activity are recognised signs of SCA in resuscitation guidelines, but more regular respiratory movements, with eyes open and rolled back, may also be present following SCA during exercise.
- ⇒ Field-of-play medical teams should be positioned so that they can access a collapsed athlete as soon as it is safe to do so.
- ⇒ Prompt recognition, high-quality chest compressions and immediate access to a defibrillator remain the key priorities during resuscitation efforts.
- ⇒ For athletes in an initial and persisting shockable rhythm, we suggest delivering a minimum of three shocks (one shock per 2 min cycle) in situ on the field of play itself.
- ⇒ Medical teams should regularly practise their immediate response to SCA in the field of play.
- ⇒ Procedures and routes for removing an athlete from the field of play and transporting them to an appropriate hospital for definitive care should be established in advance.
- ⇒ Sporting clubs and organisations should disseminate knowledge about resuscitation in the field of play to all players, staff, officials and their local communities, with a focus on early recognition, high-quality chest compressions and prompt defibrillation.

basketball).^{3,4} However, the true incidence may be under-reported.^{3,5}

In the general population, around 1 in 10 people survive to 30 days of hospital discharge following an out-of-hospital cardiac arrest.^{6–8} In exercise-associated SCA survival rates, over 80% have been reported when prompt resuscitation and on-site defibrillation are provided.^{9–13} However, there is still potential for increasing survival more consistently in organised sport by optimising the prompt recognition of SCA and the provision of early, high-quality cardiopulmonary resuscitation (CPR) and defibrillation.^{10,14,15}



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Prominent cases of SCA in professional athletes have raised public expectations that athletes should receive the best possible care to optimise their chances of survival. This best-practice guideline provides an evidence-based framework for the resuscitation of athletes who have SCA during organised sporting activity.

METHODS

The best-practice guideline described in this article is available in full from Resuscitation Council UK.¹⁶

Panel selection

Stimulated by recent cases of SCA in high-profile professional athletes, the need for a best-practice guideline for the management of SCA in the field of play was proposed to the Resuscitation Council UK. The Resuscitation Council UK Executive Committee agreed to the development of the guideline in September 2021.

This task was subsequently assigned to the Community and Ambulance Resuscitation (CARE) Subcommittee, which advises on the training and practice of resuscitation outside the hospital environment. Its focus is on improving survival by evaluation of science, development of guidelines and supporting implementation of best practice. Its members participate on a voluntary basis: they include healthcare professionals from several disciplines and representatives from charities, first aid and voluntary aid societies.

Interested members from the CARE Subcommittee and Resuscitation Council UK staff members were appointed to a task-and-finish group (see the 'Acknowledgements' section)

Evidence review

This best-practice guideline refers to global treatment recommendations, which are made following an evidence evaluation process by the International Liaison Committee on Resuscitation¹⁷ (see <https://www.ilcor.org/>). We have also referred to the European¹⁸ and Resuscitation Council UK guidelines,¹⁹ whose development is described elsewhere.²⁰ We appreciate that other national or regional resuscitation guidelines may differ slightly and, while we reference existing European and Resuscitation Council UK guidelines here, it may be more appropriate for people to apply the principles of this best-practice guideline while following the overarching guidance of their own national or regional resuscitation council. Where additional published evidence exists, we have appropriately referenced it. Where our recommendations are not explicitly set out in existing guidelines or evidence, we reached a consensus.

Consensus process

The task-and-finish group defined the scope of the enquiry and proposed initial matters for consideration in March and April 2022. The focus of this best-practice guideline was defined as SCA in athletes during organised sports when:

- ▶ There is a dedicated medical team, or another team with specific training, that is, expected to respond to medical emergencies on the field of play.
- ▶ There is the potential for other factors or competing interests (such as media or crowd safety) to detract from the focus on athlete well-being following a collapse on the field of play.

The group identified (from existing professional contacts) a group of stakeholder experts from several sporting organisations across the UK and abroad. It also identified two cardiac arrest survivors, via SCA UK (a UK charity that provides information

and support to cardiac arrest survivors and their families, <https://www.suddencardiacarrestuk.org/>).

The task-and-finish and stakeholder groups (see the 'Acknowledgements' section) had a hybrid (a mixture of face to face and virtual online) meeting on 25 April 2022 to discuss the scope and content of the guideline. A draft version was produced and revised internally by the task-and-finish group, before distribution to the stakeholder group for further commentary and revision. Both groups reviewed the resulting version in a hybrid meeting on 14 September 2022 and clarified key points. Consensus was reached through iterative discussions without a formal voting process. All task-and-finish and stakeholder group members approved the content and all the recommendations of the guideline.

The task-and-finish group finalised updates to the document in October 2022 and circulated it to the stakeholders in December 2022. Stakeholders then distributed this to interested contacts in their networks for further commentary and suggestions. We produced a revised document in February 2023.

We then made this document available for public commentary via the Resuscitation Council UK website between 20 April 2023 and 3 May 2023. During this time, we received 35 comments from 10 individuals and 1 organisation. We reviewed each item of feedback and grouped them into five main themes—content, remit/scope, stakeholder representation, document organisation and typographical errors. Our responses to public commentary and changes that we subsequently made were detailed in the published document.¹⁶

The task-and-finish group reviewed the updated document during June and July 2023. The Resuscitation Council UK Executive Committee and partner organisations approved the final draft of the document, which was published online on 6 December 2023.¹⁶

Terminology

We use 'field of play' to refer to any sporting or playing venue, including training facilities.

We refer to the care of an 'athlete' but recognise that collapse and cardiac arrest may occur in other people on or immediately adjacent to the field of play, such as team and match officials, field-of-play marshals and other involved personnel. Wherever we use the term 'athlete,' the advice given is equally applicable to these groups.

Patient and public involvement

Two SCA survivors were part of the stakeholder group and provided input at all levels of developing this guideline. The public was invited to comment on a draft of this guideline via the Resuscitation Council UK website during a 2-week period between 20 April 2023 and 3 May 2023.

Equity, diversity and inclusion

The author team (task-and-finish and stakeholder groups) included a multidisciplinary panel of resuscitation and sports medicine experts, junior scholars, administrators and patients, with members from both sexes. The guidelines are applicable to persons regardless of race, ethnicity or gender. This document provides recommendations for high-level, organised sport and thus socioeconomic disparities to implement best practices for a field-of-play medical team and all necessary resources in other settings were not addressed in detail.

RECOMMENDATIONS

When SCA occurs

Recognition

If an athlete on the field of play has an unexpected collapse and remains unresponsive, the presumption should be that this is SCA.

Agonal breathing and seizure-like movements may occur following cardiac arrest.^{21 22} Additionally, athletes who have had SCA may continue breathing more regularly^{12 23 24} and/or have their eyes open²⁵ following collapse.

Such unexpected collapse and inadequate recovery may occur:

- ▶ At any time during sporting activity.
- ▶ Away from the point of sporting action.
- ▶ Immediately after blunt-force trauma to the chest: ‘commotio cordis’, for example, collision with another athlete or equipment.

Anyone who witnesses an unexpected collapse should summon immediate medical attention so that the athlete can be assessed where they are. Even if the athlete recovers and regains consciousness quickly following an unexpected collapse, they should not continue their sporting activity. They should be removed from the field of play for prompt, detailed assessment in an appropriate medical facility.

Preparing the response to SCA

Anyone on or beside the field of play in an official capacity should be trained to recognise signs of SCA and immediately alert the field-of-play medical team. Field-of-play medical teams should be empowered to reach a collapsed athlete’s side without delay once it is safe to do so. Officials should, where necessary, halt play as soon as it is safe to do so, no matter the competitive situation on the field of play.

Safety concerns should be the only barrier to getting to a collapsed athlete as soon as possible. Competition organisers must allow medical teams to be positioned near the field of play to allow a clear view and unimpeded access in case of emergency.

Field-of-play medical teams should practise their response to SCA. This includes the team’s location or staging point, training/expertise of team members and role allocation, communication between team members (including signals to alert the emergency team to enter the field of play), specifics on managing SCA, equipment available, ambulance location, scene/crowd management and the need for a team leader who retains overall control of the resuscitation effort.²⁶ The team leader should have relevant experience and expertise in leading resuscitation teams and allocating roles appropriately in this environment. The team leader should be clearly identified before the event.

Field-of-play medical teams should liaise closely with sports teams’ own medical personnel (or, in their absence, other members of the sports team), who may reach the collapsed athlete first, to facilitate immediate access and appropriate management. It is important that these personnel can also recognise SCA and have the appropriate equipment to treat it promptly.

There should be predefined arrangements (including pre-event briefings) governing if an emergency medical service (EMS) response is required—if an ambulance is not already on-site—and what form this should take.

The field-of-play medical team should, where practicable, make competition officials aware of their presence and that their response to a suspected cardiac arrest must override the normal field-of-play access protocols. This should not result in sanctions being imposed on athlete(s) or teams, or them subsequently being considered ‘out of competition’. In some sports,

there is a requirement for medical treatment on the field of play to be completed within a specified time. This should not apply to suspected cardiac arrest.

Initial resuscitation

The focus in all circumstances should be on prompt recognition, initiation of high-quality CPR and early use of a defibrillator. Thereafter, field-of-play medical team personnel must act according to their competence.

The field-of-play medical team should approach and, wherever possible, initially treat the athlete in the location where they have collapsed. They should resist demands from other parties to move the athlete, who may not appreciate the seriousness of the situation, unless the location presents immediate safety concerns. Field-of-play medical teams should communicate to all parties that this is a cardiac arrest.

Initially, assess for signs of life and responsiveness, paying particular attention to the information provided above about recognising SCA in the field of play. If there are no signs of life and the athlete remains unresponsive perform resuscitation according to current guidelines.^{18 19}

Cardiopulmonary resuscitation

- ▶ Start CPR with high-quality chest compressions, with minimal interruptions.
- ▶ Attach a defibrillator immediately or, if one is not immediately available, as soon as it arrives, minimising interruptions to chest compressions. A defibrillator should be located at sports venues and training grounds so that a first shock, if appropriate, can be delivered within 2 min of an athlete’s collapse.
- ▶ Continue high-quality chest compressions and effective rescue breaths according to resuscitation guidelines, or chest compressions alone if there are difficulties providing rescue breaths.
- ▶ Insert a supraglottic airway (eg, i-gel or laryngeal mask airway) and provide ventilation. If suitable equipment or expertise is not available, provide ventilation using a face mask and self-inflating bag and an oropharyngeal airway. Effective face mask ventilation may require a two-person technique.
- ▶ Attach supplemental oxygen.

Using a defibrillator

It is appropriate to respond with an automated external defibrillator (AED). Field-of-play medical teams should ensure that an AED is located with them and immediately available for use.

All field-of-play medical teams should have specific training with the AED with which they will respond. Teams should review their response and their specific device (or a training analogue) before each competition session.

Field-of-play medical teams may choose to respond using a manual defibrillator if they have appropriate training and expertise and if doing so does not compromise the response to the athlete in cardiac arrest. Manual defibrillators can also be used in AED mode if this facilitates effective team management of the cardiac arrest.

Initial shockable rhythm: ventricular fibrillation or pulseless ventricular tachycardia

Deliver one shock per 2 min cycle of CPR. Do not deliver stacked shocks. If the shockable rhythm persists, deliver a minimum of

three shocks on the field of play before considering moving the athlete.

Other key considerations:

- ▶ Continue high-quality CPR and deliver further shocks (one per 2 min cycle) as required.
- ▶ Obtain intravenous or intraosseous (IO) access on the field of play if there are sufficient appropriately skilled personnel. This must not delay or interrupt chest compressions or the use of the defibrillator and must not delay a decision to move the athlete safely from the field of play.
- ▶ Give epinephrine (epinephrine) 1 mg intravenous or IO and amiodarone 300 mg intravenous or IO following the third shock if the athlete remains unresponsive, and before moving the athlete from the field of play.
- ▶ If the rhythm changes from shockable to non-shockable for more than one cycle of CPR, consider moving the athlete in preparation for immediate transfer to a hospital.

The medical team should consider and regularly practise the safest and most efficient route to move the athlete in cardiac arrest to a designated rendezvous point. This may involve a team carry-off, the use of a buggy or stretcher, or a motorised ambulance vehicle driven onto the field of play. If there are difficulties in moving the patient without minimising the interruption to high-quality CPR, continuing CPR in situ (even after three shocks) may be a better option.

When the field-of-play medical team agrees that it is safe and appropriate to do so, move the athlete to an ambulance for immediate transfer to a hospital. Field-of-play medical teams should agree on this process with the ambulance service and practise it regularly. There should be a handover using a pre-agreed brief format so as not to compromise CPR quality or delay the transfer of the athlete to definitive medical care.

As soon as the field-of-play medical team has transferred the athlete to any transport device or vehicle, it is reasonable to perform a brief repeat rhythm analysis, particularly if the time taken to load the athlete on the transfer device has been prolonged and/or further movement (eg, to an off-field ambulance) might take some time. Deliver one further shock as indicated and immediately resume chest compressions. Note that this further shock may not immediately be possible if using an AED, which will only perform further rhythm recognition after a 2 min cycle of CPR.

Initial non-shockable rhythm: pulseless electrical activity or asystole

- ▶ Continue high-quality CPR.
- ▶ Obtain intravenous or IO access on the field of play and give epinephrine (epinephrine) 1 mg as soon as possible. This must not delay or interrupt chest compressions or the use of the defibrillator (if indicated subsequently) and must not delay a decision to move the athlete safely from the field of play.
- ▶ When the field-of-play medical team agrees that it is safe and appropriate to do so, move the athlete to an ambulance for immediate transfer to the hospital.
- ▶ If the rhythm changes from non-shockable to shockable, deliver a shock. If a shockable rhythm persists for subsequent cycles, deliver a minimum of three shocks (one shock per 2 min cycle of CPR) on the field of play.

If return of spontaneous circulation occurs

Postresuscitation care, according to existing guidelines, should start immediately after a sustained return of spontaneous circulation, regardless of an athlete's location, following existing

guidelines.²⁷ Field-of-play medical teams should monitor the athlete closely and remain alert to the possibility of recurrent cardiac arrest.

Move the athlete to an ambulance and transport them to a preagreed receiving hospital as soon as the field-of-play medical team agrees that it is safe and appropriate to do so.

Special considerations

There may be sport-specific and participant-specific challenges in safely accessing and treating a collapsed athlete. Field-of-play medical teams should account for and regularly train for these challenges when responding to an athlete who has collapsed.

Examples of special circumstances are listed in [table 1](#).

Other considerations during resuscitation

Personal dignity

There should be arrangements with media companies not to broadcast live images of any medical event, and a plan to physically screen the athlete from public view if possible, provided this does not interfere with or delay resuscitation efforts. However, it may be appropriate for the field-of-play medical team to review any media footage after the event to learn and improve their response to future incidents.

AEDs and manual defibrillators

It is entirely appropriate to respond with an AED to an athlete who has had an SCA, even at the highest levels of sport.

The national governing bodies of many sports will require the presence of AEDs at certain levels of competition. We strongly recommend having an on-site AED available and immediately accessible and ready for use in locations where people are engaging in exercise and/or sporting events. Sporting organisations should have an AED positioned so that it is always accessible to the wider community (eg, in an unlocked cabinet on a premises' external wall). The location of AEDs should be indicated using clear signage that is visible at a distance.

AEDs can also be used to resuscitate infants and children.²⁸

Use a paediatric attenuator and paediatric pads for infants and children below 8 years of age if these are available. If the age of a collapsed child is uncertain do not delay CPR or defibrillation with the AED, using best judgement to determine whether to use adult or paediatric pads.

Airway management

Where possible, use a supraglottic airway for initial airway management. If the appropriate equipment or expertise is not available, provide ventilation using a face mask and self-inflating bag and an oropharyngeal airway. Effective face mask ventilation may require a two-person technique.

Consider tracheal intubation for advanced airway management only in a system where the field-of-play medical team anticipates a high first-pass success rate and can provide evidence to support this assertion. Published evidence suggests that early intubation does not improve survival or survival with favourable functional outcomes after adult cardiac arrest in any setting.²⁹ Advanced airway management must not delay or interfere with the provision of high-quality chest compressions and prompt defibrillation.

Oxygen

During CPR, use supplemental oxygen if available. Provide the highest feasible inspired oxygen concentration. After the return of spontaneous circulation, aim to achieve a normal oxygen

Table 1 Special circumstances

Circumstance	Recommendations
Water-based events, swimming pools	Do not attempt chest compressions in the water Move the athlete to the poolside before performing an assessment and starting CPR with high-quality chest compressions An AED can be used at the poolside
Water-based events, open water ⁴⁶	Do not attempt chest compressions in the water Move the athlete as quickly as possible to dry land or, if this is not practicable, to a rescue boat Rescue breaths may be provided in the water by a trained rescuer if the equipment available and distance to boat or land warrant this Consider rescue-boat size and environment ahead of the sporting event Provide CPR and use an AED in the rescue boat, but only if the boat provides a stable enough platform and there is sufficient space for this. If there is not space, it may still be possible to deliver ventilation Minimise delay in getting the athlete to shore or to a larger boat that can provide a stable platform to provide CPR/AED
Ice-based events	Plan an earlier move to an off-ice location (due to the impracticalities of spending prolonged time on the ice providing resuscitation) Apply safety covers to athlete's ice-skates as soon as practicable
Road-based events (eg, running, cycling, triathlon)	Safety of rescuer(s) from traffic and other participants moving at high speed is paramount—liaise with police and other appropriate authorities ahead of the event The event may continue if marshals can divert participants and other traffic away from the incident The athlete may also have traumatic injuries Consider trauma as a cause of the cardiac arrest
'High-speed events (eg, track cycling, skating, skiing, motor vehicle events)	Safety of rescuer(s) from other participants moving at high speed is paramount The event may continue if marshals can divert other participants away from the incident The athlete may also have traumatic injuries Consider trauma as a cause of the cardiac arrest
Equestrian events	Safety of rescuer(s) from horses is paramount The event may continue if marshals can divert other participants away from the incident The athlete may also have traumatic injuries Consider trauma as a cause of the cardiac arrest Practise how to remove body protectors and air jackets/air vests quickly to expose the chest to deliver effective chest compressions and attach a defibrillator
Events where athlete wears protective equipment	Practise how to remove protective equipment to expose the chest quickly to deliver effective chest compressions and attach a defibrillator, in such a way to prevent further injury
Events involving children and young people	There will be size and weight-based differences in cardiac arrest management. ⁴⁷ There is a need for specific paediatric resuscitation training and practice.
Endurance events	Be aware of the signs of and treatment for exertional hyperthermia, including the need for rapid, on-site cooling ⁴⁸ Consider exertional hyperthermia (\pm electrolyte disturbance) as a precipitant of cardiac arrest

AED, Automated External Defibrillator; CPR, cardiopulmonary resuscitation.

saturation if this can be reliably monitored.^{30 31} Otherwise, or if there is doubt about the accuracy of oxygen saturation readings, provide the highest feasible inspired oxygen concentration until effective monitoring is available.

Use of mechanical CPR devices

Current resuscitation guidelines do not recommend the routine use of mechanical CPR devices.^{32 33} The published evidence shows no improvement in survival or survival with good functional outcomes compared with providing manual chest compressions in the general population.³⁴

Guidelines state that mechanical chest compressions should be considered only if high-quality manual chest compressions are not practical or if doing them compromises rescuer safety^{32 33}—for example, during ambulance transport and when there are limited personnel available during the resuscitation effort. Field-of-play medical teams may, therefore, consider mechanical CPR in these circumstances and should define the circumstances for their use ahead of the event. Regular training is required to use mechanical CPR devices effectively.

Extracorporeal CPR

Data concerning the effect of extracorporeal CPR (whether performed in a prehospital or in-hospital setting) on survival and

survival with good functional outcomes are lacking.³⁵ It may be considered only as part of a preplanned, integrated emergency response with specific training, involving field-of-play medical teams, EMS and an appropriate receiving hospital. The benefit is more likely in the following situations (most, if not all, of which are likely to apply to athletes sustaining SCA in the field of play, particularly at higher levels of competition):

- ▶ Witnessed event.
- ▶ Primary cardiac cause.
- ▶ Early onset of bystander CPR.
- ▶ Age under 65 years.
- ▶ Time from collapse to initiation of extracorporeal CPR of no more than 60 min.

Traumatic collapse

The field-of-play medical team may sometimes have to decide whether a sudden collapse is due to the effects of traumatic injury (eg, head and neck injury or severe haemorrhage) or because of a primary cardiac arrhythmia (eg, commotio cordis). Field-of-play medical teams who may have to make this assessment should be experienced in and practise the management of traumatic cardiac arrest, following existing guidelines.^{36 37} Athletes who remain unresponsive and without signs of life following a traumatic collapse should be presumed to be in cardiac arrest.

Impact brain apnoea (cessation of breathing following a traumatic brain injury) is another recognised phenomenon that prompt, appropriate airway management can ameliorate.³⁸

Moving athletes from the field of play with ongoing resuscitation

If moving an athlete off the field of play with ongoing resuscitation, there should be a clear, predetermined plan about where the athlete is being moved to. Restricted access to the athlete may delay or impede resuscitation and the use of some equipment and may influence this decision.

If a decision has been made to transport the athlete to a hospital, move them from the field of play to an ambulance if available. If an ambulance is not immediately available, move them to a preagreed ambulance rendezvous point, with a view to immediate loading and transfer once the ambulance arrives.

Ideally, do not move the athlete to another part of the sports venue, such as a separate medical room, to provide ongoing resuscitation before transfer to the ambulance. If there are necessary reasons for doing this (eg, design and location of the venue) the field-of-play medical team should practise this to minimise delays to hospital transfer.

Transporting athletes to a hospital with ongoing CPR

CPR quality, survival to hospital discharge and survival with favourable neurological outcomes are worse in people who are transported in an ambulance with ongoing CPR, rather than when CPR is completed at the scene of their cardiac arrest.³⁹

However, this evidence is not specific to those who have SCA in the field of play. Medical teams can reasonably consider moving an athlete in cardiac arrest to a hospital earlier than would be advised for the general population. The athletes are likely to be younger, fitter and more likely to have had a witnessed event with early resuscitation. It should be clear to all involved that such a transfer offers a potential benefit to the patient. There should be a brief handover using a preagreed format once the athlete reaches the hospital.

Ideally, take athletes with SCA to a designated 'cardiac arrest centre'. It should have expertise in out-of-hospital cardiac arrest management and round-the-clock access to relevant services, such as cardiac electrophysiology, CT, coronary angiography and percutaneous coronary intervention, echocardiography, extracorporeal CPR and intensive care.⁴⁰

It is important that the field-of-play medical team liaise in advance with EMS and local hospital(s) to identify an appropriate receiving hospital, establish a prealert system, and, where necessary, protocols to allow bypass of hospitals that may be nearer but without these facilities. In cases of cardiac arrest secondary to significant trauma, transfer to a major trauma centre may be more appropriate.

Organisation and training

The effective implementation of these guidelines will require the cooperation of several agencies, including competition organisers, the host venue and team, independent medical providers, health system resources and national sports governing bodies.

A comprehensive emergency action plan is a crucial part of the prompt and effective response to an athlete who has had SCA.⁴¹ We recommend the development of an emergency action plan based on relevant field-of-play regulations for that sport and its international federation, and up-to-date risk assessments of the sports activity and venue(s) in question. The emergency

action plan should be reviewed and rehearsed on a regular basis. A suggested emergency action plan is provided in [box 1](#).

SCA also may occur on the field of play during training as well as during competition. Athletes may train (at training venues) far more than they play (at a competition venue) and the availability of field-of-play medical teams at different venues may not be the same. Emergency response plans should consider this. For competitions, a pre-event medical meeting should gather medical and emergency care personnel prior to a competition to review the emergency action plan and enhance coordination before an emergency occurs. This meeting, also referred to as a pre-event 'medical time out', should include home and visiting team medical personnel, venue medical staff and officials, and emergency care personnel.⁴²

Organisations should also have detailed plans about training for the dedicated teams that respond to an athlete with SCA, including the content of training and the frequency with which training is provided. Some sports will already have specific directions about the composition and training of the field-of-play medical team(s). Training should be consistent with current resuscitation guidelines and include:

- ▶ Training on any additional or advanced equipment that they may be used.
- ▶ Scenario-based training, whenever possible in the setting where the sports events or training take place.
- ▶ Sports and participant-specific training.
- ▶ Role-specific training for each team member.

There should also be plans for training other people who may witness an athlete collapsing on the field of play, such as team, venue and match officials, which include details about frequency and content of refresher training. This training should include, at a minimum, recognition of SCA in the field of play, delivery of high-quality chest compressions and familiarisation with and use of an AED. There are several virtual or online resources that demonstrate what SCA can look like,⁴³ including on the field of play.⁴⁴

Field-of-play officials and venue managers should have an understanding of the principles guiding the transfer of a collapsed athlete from the field of play and transport to a hospital.

Dissemination of best practice

There are clear opportunities to disseminate best practice to improve recognition of SCA in the field of play, empower people to perform bystander CPR and use an AED and encourage the placement of AEDs, always accessible to the public, in sporting venues and other public locations.

DISCUSSION

Policy implications

This best-practice guideline is aimed primarily at people organising, leading or participating in a dedicated field-of-play medical team responding to SCA. It is designed to complement, rather than supersede, existing out-of-hospital cardiac arrest guidelines for the management of out-of-hospital cardiac arrest.^{18 45} The European Resuscitation Council³⁶ and Resuscitation Council UK³⁷ also address cardiac arrest occurring during sport in 'Special Circumstances' sections of their current guidelines.

Some sports already have specific directions regarding the composition and training of a field-of-play medical team.²⁶ Again, this guideline is complementary to existing practice.

A formal best-practice guideline, written according to best evidence where available and expert opinion where not, can empower field-of-play medical teams to act in the best interests

Box 1 Suggested elements for an emergency action plan (EAP) for sudden cardiac arrest (SCA) on the field of play

How athletes, team, venue and match officials recognise possible SCA when someone collapses on the field of play.

The location or staging point of the field-of-play medical team, and how they will gain access to a collapsed athlete safely and rapidly.

The nature of a pre-event medical meeting to review the EAP and its implementation.

Who will perform CPR and defibrillation.

Who will purchase and maintain defibrillator(s) and make them immediately available when needed.

Whether to use an AED or a manual defibrillator.

Location of all AED and who will retrieve the closest one in case of an emergency.

How to maintain the safety and dignity of the athlete during initial resuscitation and when moving them from the field of play.

How to perform essential interventions on the field of play following SCA.

Which advanced interventions to perform on the field of play, and how to perform them, following SCA.

Moving an athlete from the field of play and transporting them to a hospital:

- ⇒ Mode of transport.
- ⇒ Positioning of a waiting ambulance relative to the field of play—including if ambulance can come directly onto field of play or not.
- ⇒ Immediate destination after leaving the field of play.
- ⇒ Geographical location (eg, GPS) if additional medical resource are required.

How protocols should differ for sport-specific special circumstances, for example:

- ⇒ Moving an athlete to a place of safety and using rescue aids, where necessary, following collapse in water.
- ⇒ The possibility of traumatic injury and danger to rescuers in equestrian events and high-speed events.

How protocols should differ for participant-specific special circumstances, for example:

- ⇒ Children or young people.
- ⇒ Athletes with impairments.

The composition of the field-of-play medical team(s):

- ⇒ Number of people.
- ⇒ Expertise and skills.
- ⇒ Team leadership
- ⇒ Role during the response and positioning around an athlete who has collapsed.
- ⇒ Provision of appropriate medical equipment.
- ⇒ Positioning of and access to medical equipment, including that carried immediately to a collapsed athlete and more advanced equipment that might be needed subsequently.

Communication issues:

- ⇒ Between team leader and team.
- ⇒ Between different teams.
- ⇒ Devices (eg mobile phones, radios), including provision for remote areas and back-ups should primary communication methods fail.

The need to have clear guidelines about the different roles and responsibilities of field-of-play medical team(s) and other team(s) tasked with dealing with medical emergencies in the crowd and/or surrounding environs. The need to have clear guidelines about

Box 1 Continued

offering appropriate debriefing and support to athletes, officials and others who have witnessed or helped treat someone in cardiac arrest.

of the athlete who has SCA. It can inform discussions with sporting bodies and officials to remove the threat of censure for sports teams or individuals should the medical team's entry to the sporting arena interrupt play.

This best-practice guideline was developed by Resuscitation Council UK with a UK readership in mind, but it is likely to be applicable internationally.

Clinical implications

This best-practice guideline provides a common framework for field-of-play medical teams responding to SCA in athletes. This guidance highlights the need to avoid compromising the safety of a collapsed athlete because of inappropriate or premature movement from the field of play, particularly in high-profile events where there might be external pressures to do so.

The essential practices of CPR remain unchanged, with a focus on high-quality CPR, with minimum interruptions and defibrillation delivered as early as possible. The guidance provides additional guidance on recognising SCA and lowers the threshold for presuming SCA in the collapsed and unresponsive athlete. There is specific direction about performing essential interventions in situ, particularly regarding repeated defibrillation in cardiac arrests with a persisting shockable rhythm. There is a risk to athletes at training venues as well as competition venues and taking steps to ensure effective medical (and AED) cover at both types of location is important.

Much of the best practice detailed in this document is also applicable to those taking part in sporting activity at all levels of competition, particularly when there is some organised medical or first-aid response. This will include team and individual sports and organised amateur or mass-participation events. Individuals or teams responding to cardiac arrest in these settings should follow existing guidelines for community-based out-of-hospital cardiac arrest²¹ and only use advanced practices and equipment described here if they have the appropriate training and expertise to do so.

If cardiac arrest occurs during sporting activity where there is no organised medical or first-aid response, people should again follow existing guidelines for community-based out-of-hospital cardiac arrest.

High-profile sporting teams have a significant opportunity to disseminate best practices to other sports teams and organisations in their local community, particularly about recognising cardiac arrest, performing CPR and use of publicly accessible AEDs.

Research implications

Most resuscitation guidelines concern out-of-hospital cardiac arrest in the general population. In particular, there is a lack of evidence in the general population for the efficacy of endotracheal intubation,²⁹ the use of oxygen,^{30 31} mechanical CPR,³⁴ extracorporeal CPR³⁵ and transport during cardiac arrest,³⁹ but the utility of these interventions for athletes on the field of play has not been established.

Continued

Strengths and limitations

This best-practice guideline considered the relevant scientific literature and international guidelines. We had representation from people with lived experience with SCA and we sought and then acted on public feedback.

There was no competitive process for membership in the group. Two important points of public feedback commented that representation could have been widened to (a) other charitable organisations with relevant experience and (b) the British Basketball League, especially given the recognised increased risk in basketball players.^{3,4} We acknowledge this as a potential limitation, although experts from several national and international sporting bodies were represented.

CONCLUSION

While SCA in athletes on the field of play is infrequent, on-site medical teams should have a planned, practised and efficient response. The unique circumstance of witnessing SCA during sports makes high survival rates likely. This best-practice guideline provides a clear approach to treating an athlete after SCA and organising the medical response in order to optimise outcomes.

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REFERENCES

- Albert CM, Mittleman MA, Chae CU, *et al*. Triggering of sudden death from cardiac causes by vigorous exertion. *N Engl J Med* 2000;343:1355–61.
- Marijon E, Tafflet M, Celermajer DS, *et al*. Sports-related sudden death in the general population. *Circ* 2011;124:672–81.
- Harmon KG, Drezner JA, Wilson MG, *et al*. Incidence of sudden cardiac death in athletes: a state-of-the-art review. *Br J Sports Med* 2014;48:1185–92.
- Peterson DF, Kucera K, Thomas LC, *et al*. Aetiology and incidence of sudden cardiac arrest and death in young competitive athletes in the USA: a 4-year prospective study. *Br J Sports Med* 2021;55:1196–203.
- Emery MS, Kovacs RJ. Sudden cardiac death in athletes. *JACC Heart Fail* 2018;6:30–40.
- Kiguchi T, Okubo M, Nishiyama C, *et al*. Out-of-hospital cardiac arrest across the world: first report from the International liaison committee on resuscitation (ILCOR). 2020;152:39–49.
- Yan S, Gan Y, Jiang N, *et al*. The global survival rate among adult out-of-hospital cardiac arrest patients who received cardiopulmonary resuscitation: a systematic review and meta-analysis. *Crit Care* 2020;24:61.
- Gräsner J-T, Wnent J, Herlitz J, *et al*. Survival after out-of-hospital cardiac arrest in Europe - Results of the EuReCa TWO study. *Resuscitation* 2020;148:218–26.
- Grubic N, Hill B, Phelan D, *et al*. Bystander interventions and survival after exercise-related sudden cardiac arrest: a systematic review. *Br J Sports Med* 2022;56:410–6.
- Drezner JA, Peterson DF, Siebert DM, *et al*. Survival after exercise-related sudden cardiac arrest in young athletes: can we do better? *Sports Health* 2019;11:91–8.
- Drezner JA, Toresdahl BG, Rao AL, *et al*. Outcomes from sudden cardiac arrest in US high schools: a 2-year prospective study from the National registry for AED use in sports. *Br J Sports Med* 2013;47:1179–83.
- Tanaka H, Kinoshita T, Tanaka S, *et al*. Prehospital interventions and neurological outcomes in marathon-related sudden cardiac arrest using a rapid mobile automated external defibrillator system in Japan: a prospective observational study. *Br J Sports Med* 2022;56:bjsports-2021-104964:1210–7.
- Schattenkerk J, Kucera K, Peterson DF, *et al*. Socioeconomic factors and outcomes from exercise-related sudden cardiac arrest in high school student-athletes in the USA. *Br J Sports Med* 2022;56:138–43.
- Aschieri D, Penela D, Pelizzoni V, *et al*. Outcomes after sudden cardiac arrest in sports centres with and without on-site external defibrillators. *Heart* 2018;104:1344–9.
- Kinoshita T, Tanaka S, Sagisaka R, *et al*. Mobile automated external defibrillator response system during road races. *N Engl J Med* 2018;379:488–9.
- Resuscitation Council UK. Resuscitation on the field of play: a best-practice guideline. 2023. Available: <https://www.resus.org.uk/get-involved/resuscitation-on-the-field-of-play> [Accessed 25 Jun 2024].
- Berg KM, Bray JE, Ng KC, *et al*. 2023 International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations: summary from the basic life support; advanced life support; pediatric life support; neonatal life support; education, implementation, and teams; and first aid task forces. *Resuscitation* 2023;2023:109992.
- Perkins GD, Gräsner J-T, Semeraro F. European resuscitation council guidelines 2021: executive summary. *Resuscitation* 2021;161:1–60.
- Resuscitation Council UK. 2021 resuscitation guidelines. 2021. Available: <https://www.resus.org.uk/library/2021-resuscitation-guidelines> [Accessed 25 Jun 2024].
- Resuscitation Council UK. 2021 resuscitation guidelines. Guidelines process. 2021. Available: <https://www.resus.org.uk/library/2021-resuscitation-guidelines/guidelines-process> [Accessed 25 Jun 2024].
- Perkins GD, Colquhoun M, Deakin CD, *et al*. Resuscitation guidelines. Adult basic life support guidelines. 2021. Available: <https://www.resus.org.uk/library/2021-resuscitation-guidelines/adult-basic-life-support-guidelines> [Accessed 25 Jun 2024].
- Olasveengen TM, Semeraro F, Ristagno G, *et al*. European resuscitation council guidelines 2021: basic life support. *Resuscitation* 2021;161:98–114.
- Drezner JA, Rogers KJ. Sudden cardiac arrest in intercollegiate athletes: detailed analysis and outcomes of resuscitation in nine cases. *Heart Rhythm* 2006;3:755–9.
- Drezner JA, Rao AL, Heistand J, *et al*. Effectiveness of emergency response planning for sudden cardiac arrest in United States high schools with automated external defibrillators. *Circ* 2009;120:518–25.
- Steinskog DM, Solberg EE. Sudden cardiac arrest in sports: a video analysis. *Br J Sports Med* 2019;53:1293–8.
- Patterson M, Gordon J, Boyce SH, *et al*. Set-piece approach for medical teams managing emergencies in sport: introducing the FIFA poster for emergency action planning (PEAP). *Br J Sports Med* 2022;56:715–7.
- Nolan JP, Sandroni C, Böttiger BW, *et al*. European resuscitation council and European society of intensive care medicine guidelines 2021: post-resuscitation care. *Intensive Care Med* 2021;47:369–421.

- 28 Skellett S, Maconochie I, Bingham R, *et al.* 2021 resuscitation guidelines. paediatric basic life support guidelines. 2021. Available: <https://www.resus.org.uk/library/2021-resuscitation-guidelines/paediatric-basic-life-support-guidelines> [Accessed 25 Jun 2024].
- 29 Granfeldt A, Avis SR, Nicholson TC, *et al.* Advanced airway management during adult cardiac arrest: a systematic review. *Resuscitation* 2019;139:133–43.
- 30 Holmberg MJ, Nicholson T, Nolan JP, *et al.* Oxygenation and ventilation targets after cardiac arrest: a systematic review and meta-analysis. *Resuscitation* 2020;152:107–15.
- 31 Bernard SA, Bray JE, Smith K, *et al.* Effect of lower vs higher oxygen saturation targets on survival to hospital discharge among patients resuscitated after out-of-hospital cardiac arrest: the EXACT randomized clinical trial. *JAMA* 2022;328:1818–26.
- 32 Soar J, Böttiger BW, Carli P, *et al.* European resuscitation council guidelines 2021: adult advanced life support. *Resuscitation* 2021;161:115–51.
- 33 Soar J, Deakin CD, Nolan JP, *et al.* Adult advanced life support guidelines. 2021. Available: <https://www.resus.org.uk/library/2021-resuscitation-guidelines/adult-advanced-life-support-guidelines> [Accessed 25 Jun 2024].
- 34 Gates S, Quinn T, Deakin CD, *et al.* Mechanical chest compression for out of hospital cardiac arrest: systematic review and meta-analysis. *Resuscitation* 2015;94:91–7.
- 35 Suverein MM, Delnoij TSR, Lorusso R, *et al.* Early extracorporeal CPR for refractory out-of-hospital cardiac arrest. *N Engl J Med* 2023;388:299–309.
- 36 Lott C, Truhlář A, Alfonzo A, *et al.* European resuscitation council guidelines 2021: cardiac arrest in special circumstances. *Resuscitation* 2021;161:152–219.
- 37 Deakin CD, Soar J, Davies R, *et al.* Resuscitation guidelines. Special circumstances guidelines. 2021. Available: <https://www.resus.org.uk/library/2021-resuscitation-guidelines/special-circumstances-guidelines> [Accessed 25 Jun 2024].
- 38 Wilson MH, Hinds J, Grier G, *et al.* Impact brain apnoea - a forgotten cause of cardiovascular collapse in trauma. *Resuscitation* 2016;105:52–8.
- 39 Wyckoff MH, Greif R, Morley PT, *et al.* 2022 International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations: summary from the basic life support; advanced life support; pediatric life support; neonatal life support; education, implementation, and teams; and first aid task forces. *Resuscitation* 2022;181:208–88.
- 40 Yeung J, Matsuyama T, Bray J, *et al.* Does care at a cardiac arrest centre improve outcome after out-of-hospital cardiac arrest? - A systematic review. *Resuscitation* 2019;137:102–15.
- 41 Pelto HF, Drezner JA. Design and implementation of an emergency action plan for sudden cardiac arrest in sport. *J Cardiovasc Transl Res* 2020;13:331–8.
- 42 Courson R, Henry G, Borque K, *et al.* Pre-event 'medical time out.' *Br J Sports Med* 2024;58:763–5.
- 43 Resuscitation Council UK. Unit 9 lifesaver. Available: <https://life-saver.org.uk/> [Accessed 25 Jun 2024].
- 44 UW Medicine Center for Sports Cardiology. How to SAVE a LIFE - recognize sudden cardiac arrest in athletes. 2023. Available: <https://www.youtube.com/watch?v=i-IN9o-cKu0> [Accessed 25 Jun 2024].
- 45 Merchant RM, Topjian AA, Panchal AR, *et al.* Part 1: executive summary: 2020 American heart association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circ* 2020;142:S337–57.
- 46 Barcala-Furelos R, Schmidt A, Webber J, *et al.* Immediate resuscitation in-water or delaying until on land strategies for drowning consensus on science with treatment recommendations. Brussels, Belgium International Liaison Committee on Resuscitation (ILCOR) Advanced Life Support Task Force; 2022. Available: <https://costr.ilcor.org/document/immediate-resuscitation-in-water-or-delaying-on-land-in-drowning-bls-tf-sr> [accessed 25 Jun 2024]
- 47 Resuscitation Council UK. Guidelines 2021. Paediatric emergency drug chart. 2021. Available: <https://www.resus.org.uk/sites/default/files/2021-05/2492%20AAP%20RCUK%20PET%20chart-5.pdf> [Accessed 25 Jun 2024].
- 48 Hosokawa Y, Racinais S, Akama T, *et al.* Prehospital management of exertional heat stroke at sports competitions: International Olympic committee adverse weather impact expert working group for the Olympic games Tokyo 2020. *Br J Sports Med* 2021;55:1405–10.