



Training/Practice
Health Policy and Promotion

Automated External Defibrillator and Emergency Action Plan Preparedness Amongst Canadian University Athletics

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ABSTRACT

Sudden cardiac death is the leading medical cause of death in athletes. The use of an automated external defibrillator (AED) and an emergency action plan (EAP) are effective strategies for improving outcomes of sudden cardiac arrest. The availability of an AED and the presence of an EAP amongst Canadian universities (U-SPORTS) are unknown. Surveys were sent to the athletic directors from U-SPORTS representing the universities within Canada. Questions were directed towards AED and EAP preparedness. All schools reported an on-site AED for sanctioned events. However, less than half of schools reported bringing the AED on-site for field sports. A total of 89% of U-SPORTS universities estimated that their EAP is capable of delivering defibrillation within 5 minutes of collapse. The majority of U-SPORTS universities have accessible AEDs and satisfactory EAP strategies. However, AED availability and EAPs during sport require continuous improvement.

RÉSUMÉ

La mort cardiaque subite est la première cause de décès chez les athlètes. Le recours à un défibrillateur externe automatisé (DEA) et à un plan d'intervention en cas d'urgence (PIU) sont des stratégies efficaces pour améliorer l'issue de l'arrêt cardiaque soudain. On ignore dans quelle mesure les équipes sportives universitaires canadiennes (membres de l'organisation U-SPORTS) disposent d'un DEA et d'un PIU. Un questionnaire a été envoyé aux directeurs sportifs de l'organisation U-SPORTS représentant les universités canadiennes. Les questions portaient sur la disponibilité d'un DEA et d'un PIU. Toutes les universités ont indiqué disposer d'un DEA sur place lors des événements sanctionnés par l'organisation. Par contre, moins de la moitié des universités ont déclaré apporter un DEA sur place lors des activités sportives de plein air. Au total, 89 % des universités faisant partie de l'organisation U-SPORTS estimaient que leur PIU permettait de procéder à une défibrillation dans les 5 minutes suivant l'arrêt cardiaque. La majorité des universités membres de l'organisation U-SPORTS disposent d'un DEA et d'un PIU satisfaisant, mais la disponibilité d'un tel appareil et le caractère approprié du PIU durant les activités sportives doivent faire l'objet d'une amélioration continue.

Sudden cardiac death (SCD) is the leading medical cause of death in young athletes.¹ A sudden cardiac arrest (SCA) is a life-threatening event that requires prompt recognition and delivery of medical care.² Access to and use of an automated external defibrillator (AED) in the setting of SCA has been an effective strategy to improve survival.^{3,4} The time to defibrillation has a significant impact on neurologically intact survival; with each minute that defibrillation is delayed, survival decreases up to 10%.⁵ However, the survival of a young athlete who suffers a cardiac arrest

is > 85% if the event is witnessed, the school has an emergency action plan (EAP), and the victim receives timely cardiopulmonary resuscitation and defibrillation.⁴ An EAP is a written and structured strategy that is specific to each athletic venue and encompasses communication, personnel, equipment, and transfer to hospital. A goal of less than 3 to 5 minutes from the time of collapse to the first shock is strongly recommended.² The prevalence of AEDs and EAP preparedness within Canadian universities is unknown. Institutions within U-SPORTS (Canada's governing body of post-secondary school sports) were surveyed regarding current AED availability and EAP implementation.

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See page 95 for disclosure information.

Methods

U-SPORTS (formerly known as the *Canadian Interuniversity Sport/Sport Interuniversitaire Canadien*) is the national

governing body of university sport in Canada. There are 65 universities, 12 sanctioned sports, and roughly 12,000 athletes participating under the U-SPORTS governing body. Yearly, there are > 7700 sanctioned competitions with a significantly higher number of unsanctioned events (practices and scrimmages) (<https://usports.ca/en/about/history>). A quantitative written survey containing 12 questions was sent to all athletic directors by U-SPORTS administration. Athletic directors are responsible for upholding appropriate medical precautions at university sporting venues. Questions were centred around AED and EAP readiness at sporting venues with emphasis on the prevalence, location, and past utilization of AEDs, along with the presence of an EAP and trained personnel at practices and competitions (Supplemental Material). Participants were directed to a password-protected server to complete the anonymous survey in either French or English. The invitation was e-mailed 4 times over an 8-week period in April 2018. Data was collected via online password-protected and secure server surveys using the Qualtrics platform.

Results

The response rate for the survey was 55.4% (36/65). The number of varsity athletes at the participating U-SPORTS institutions ranged from 70 to 1200 (mean 313). Multiple members of the athlete care team had basic life support training. Basic life support training was endorsed by 94.4% of athletic therapists, 41.6% of physiotherapists, 22.2% of athletic directors, 30.5% of coaches, and 55.6% by others. All respondents reported that an AED was available on-site for every sanctioned sporting event. During practices, AED accessibility decreased slightly to 94.4%. For field sports (not within a stadium or gymnasium), an AED was brought onto the field of play less than half the time (47.2%). In those cases where an AED was not brought onto the field, the mean

distance from the AED was 147.5 m (± 31.3 m). The majority of schools (91.6%) reported that there was a dedicated person(s) with basic life support training at all sanctioned games, and two-thirds of schools mandated AED and cardiopulmonary resuscitation training for athletic personnel.

All institutions stated that an EAP was in place, with 86.1% of schools reporting that the EAP was reviewed annually, 5.5% of schools reviewed the EAP every 6 months, 5.5% reviewed the EAP every 2 years, and 1 school did not review the EAP. The time (on average) from recognizing an emergency to delivering therapy with an AED was estimated to be < 3 minutes (47.2%), 3 to 5 minutes (41.6%), 5 to 7 minutes (8.3%), and > 7 minutes in 2.7% (Fig. 1) Half the respondents stated that an AED had been used at their school during a sporting event. However, specific details regarding those cardiac arrests (athlete vs spectator), time to defibrillation, and outcomes are not available.

Discussion

Tremendous efforts have been made to prevent SCD in young athletes. Preparticipation screening has been proposed as a potential method to reduce SCD by identifying at-risk athletes who may harbour clinically silent cardiac conditions associated with SCD. However, the identification of all athletes with an underlying cardiac condition that predisposes them to a higher risk of SCD is a formidable challenge; many causes of SCD are not readily detected by preparticipation screening (ie, premature coronary artery disease, myocarditis, idiopathic ventricular fibrillation, coronary artery anomalies, concealed long QT syndrome) or may not yet have clinically manifested (arrhythmogenic right ventricular cardiomyopathy, hypertrophic cardiomyopathy). Furthermore, predicting which young persons with cardiac disease will, and when they will, experience SCA is unlikely. What is more predictable is

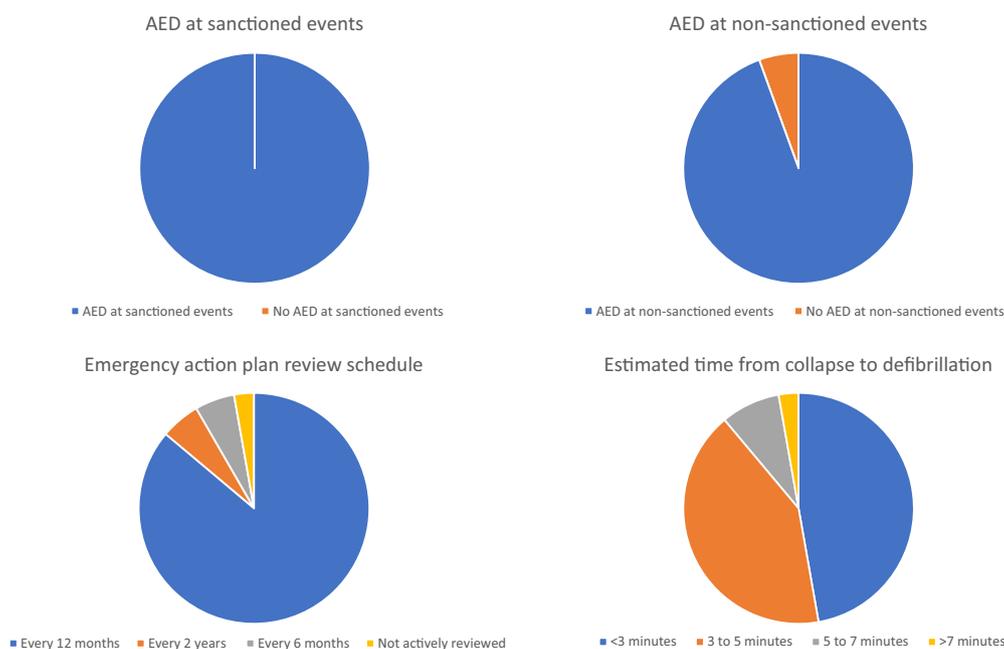


Figure 1. Select results from participating U-SPORTS institutions regarding the presence of an automated external defibrillator (AED) and emergency action plan preparedness.

the outcome of a young person who suffers SCA when an AED is used in a timely fashion. In high schools with an on-site AED, 89% of high school student athletes who experienced SCA survived.⁴ In an 18-year observational study examining the impact of an on-site AED in community sports centres, the rate of neurologically intact survival was 93% in centres with an on-site AED, but only 9% in centres without ($P < 0.001$).³ A multivariate analysis demonstrated that the presence of an on-site AED was the strongest factor predicting neurologically intact survival (odds ratio 142 [7.7-2520]).³

Inter-Association Task Force recommendations on emergency preparedness and management of sudden cardiac arrest in high school and college athletic programs recommend that all institutions that sponsor athletic activities have a written and structured EAP.² The EAP should be specific to each athletic venue and encompass emergency communication, personnel, equipment, and transportation.² In addition, they recommend that the EAP be reviewed and practiced at least once per year with certified athletic trainers, team and consulting physicians, athletic training students, school and institutional safety personnel, administrators, and coaches. See [Table 1](#) for EAP recommendations.

All schools stated that an AED is present at all sanctioned games, and at the great majority (94.4%) of unsanctioned events (practices). However, an AED was physically brought to the field of play for field sports (not within an arena or gymnasium) less than half of the time (47.2%) with distance from the closest AED approximately 150 m. One could envision that even in the most well-rehearsed EAPs the time to travel to find the AED and then return to the site of the arrest (approximately 300 m) could lead to delays in timely defibrillation. This time could easily be magnified in situations where EAPs are not routinely practiced, particularly if the precise location of the AED is unknown. Practice fields may exhibit magnified risk as they are further from central locations (ie, stadiums and arenas) where AEDs and support staff may be placed for accessibility. Guidelines recommend that an AED be in the immediate vicinity (within a 3-minute walk) to the place of play.⁵ In accordance with guidelines, the majority (86.1%) of U-SPORTS institutions practice their EAP on an annual basis, and 88.9% state that the time from collapse to first defibrillation is < 5 minutes, with 47.2% reporting < 3 minutes. It is possible that these numbers may be the best-case scenario as institutions that do not have documented and rehearsed EAPs may have been less likely to respond.

Unexpectedly, over half of the respondents (18) reported that an AED had been used at their institution. Unfortunately, granular data regarding the situation of the arrest (athlete vs spectator, age of victim, time to defibrillation, outcome, and date of arrest) are unavailable. Furthermore, it is possible that the same arrest was witnessed by multiple athletic directors. However, what is clear is that AEDs are being used at U-SPORTS events in efforts to abort SCD. A structured reporting system or registry of SCA among U-SPORTS would be of great value.

Limitations

Conclusions drawn are based on the limited number of institutions that completed the survey. The results may be affected by response bias as schools that possess accessible AEDs and have

Table 1. Summary of consensus recommendations on emergency preparedness and management of sudden cardiac arrest*

- (1) Every school or institution that sponsors athletic activities should have a written and structured emergency action plan.
- (2) The emergency action plan should be developed and coordinated in consultation with local EMS personnel, school public safety officials, onsite first responders, and school administrators.
- (3) The emergency action plan should be specific to each individual athletic venue and encompass emergency communication, personnel, equipment, and transportation to appropriate emergency facilities.
- (4) The emergency action plan should be reviewed and practiced at least annually with certified athletic trainers, team and consulting physicians, athletes, school and institutional safety personnel, administrators, and coaches.
- (5) All members of the athlete care team (athletic director, medical professionals, athletic therapists, physiotherapists, coaches, and athletes) should be educated at least annually about the location, function, and use of automated external defibrillator (AEDs).
- (6) All members of the athlete care team should be educated on the recognition of a cardiac arrest.
- (7) Ensure the training of anticipated responders in cardiopulmonary resuscitation and AED use. Such training should not be limited to athletic therapists and team physicians, but should rather be inclusive, including, but not limited to, coaches, physiotherapists, administrative personnel, and student athletes if resources permit.
- (8) An AED should be on-site and readily available within a 3-min walk (with 1 min being ideal) for all organized athletic activities. For field sports, it is preferred that an AED is physically brought to the field of play to reduce time from collapse to defibrillation.
- (9) Access to early defibrillation is essential, and a target goal of less than 3 min from the time of collapse to the first shock is strongly recommended.
- (10) Review of equipment readiness and the emergency action plan by on-site event personnel for each athletic event is desirable.

*References from consensus documents are available in the [Supplemental Material](#).

implemented EAPs may have been more likely to respond, and thus there is the potential that the results may overestimate the actual AED availability and EAP preparedness. Furthermore, the quality of the data is subject to recall bias. The adequacy of the EAP was assumed to be sufficient as the authors did not have access to the individual institutions' written EAPs. Furthermore, the reported time to apply an AED and distance to the nearest AED is based on reported values and may be an estimation as opposed to a timed or direct measure. Specific data regarding the deployment of an AED during reported cardiac arrests were unavailable due to concerns regarding accuracy of information from recall without access to emergency health record documentation. Inferences regarding SCA during Canadian university sport cannot be made. The data are limited to collegiate sports within Canada under U-SPORTS, and it cannot be assumed that similar response rates are present in high schools, recreational sporting leagues, amateur, or professional sports.

Conclusions

Of the U-SPORTS universities that responded, all had an AED available at sanctioned games, and the majority of schools had an AED available at unsanctioned events (practices). However, less than half of universities reported bringing an AED to the field of play for field sports. The majority of schools reported adequate EAPs that met guidelines with respect to annual review and time to defibrillation of < 5 minutes. AEDs and EAPs are proven to be a highly effective measure to reduce SCD; continuous improvements in AED access and rehearsal of EAPs are necessary.

Disclosures

The authors have no conflicts of interest to disclose.

References

1. Malhotra A, Dhutia H, Finocchiaro G, et al. Outcomes of cardiac screening in adolescent soccer players. *N Engl J Med* 2018;379:524-34.
2. Drezner JA, Courson RW, Roberts WO, et al. Inter-Association Task Force recommendations on emergency preparedness and management of sudden cardiac arrest in high school and college athletic programs: a consensus statement. *Heart Rhythm* 2007;4:549-65.
3. 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.
4. Drezner JA, Toresdahl BG, Rao AL, Huszti E, Harmon KG. 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.
5. Hainline B, Drezner JA, Baggish A, et al. Interassociation consensus statement on cardiovascular care of college student-athletes. *J Am Coll Cardiol* 2016;67:2981-95.

Supplementary Material

To access the supplementary material accompanying this article, visit the online version of the *Canadian Journal of Cardiology* at www.onlinecjc.ca and at <https://doi.org/10.1016/j.cjca.2018.10.012>.