

## **ABSTRACT**

**BACKGROUND:** This review examines the breadth of first aid training delivered to school students and the components that are age appropriate to adolescents.

**METHOD:** Eligible studies included school-based first aid interventions targeting students aged between 10 and 18 years. Online databases were searched, for peer-reviewed publications available as at August, 2014.

**RESULTS:** Twenty journal articles were relevant to the review. Research supported programs with longer durations (3 hours or more). Most programs taught resuscitation alone and few included content that was context specific and relevant to the target group. The training experience of the facilitator did not appear to impact on student outcomes.

Incorporating both practical and didactic components was found to be an important factor in delivering material and facilitating the retention of knowledge. Educational resources and facilitator training were found to be common features of effective programs.

**CONCLUSIONS:** The review supports first aid in school curriculum and provides details of key components pertinent to design of school-based first aid programs. The findings suggest that first aid training may have benefits wider than the uptake and retention of knowledge and skills. There is a need for future research, particularly randomised controlled trials to aid in identifying best practice approaches.

**Keywords:** school-based training, school health programs, first aid, cardiopulmonary resuscitation, systematic review

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as doi: [10.1111/josh.12373](https://doi.org/10.1111/josh.12373)

Injury is a major challenge to health representing the largest cause of early morbidity and mortality and the leading cause of death among adolescents.<sup>1</sup> Evidence from school-based first aid programs shows training can be implemented successfully, thereby providing a setting for teaching skills to reduce injury severity<sup>2</sup> and increasing basic life support (BLS) knowledge.<sup>3</sup> Importantly, school-based first aid interventions could have the potential to educate a wide cross section of the community in such skills.<sup>4</sup> Literature demonstrates that the widespread dissemination of first aid may have benefits for injury prevention in terms of reducing traffic crashes,<sup>5</sup> lowering rates of workplace incidents, and increasing safety awareness.<sup>6</sup> Research shows benefits to first aid in injury prevention and control.

There has been support in for including cardiopulmonary resuscitation (CPR) training in schools with the aim of increasing the rate of bystander CPR, thereby increasing the survival rate of out of hospital cardiac arrest.<sup>7,8</sup> When a person is injured actions taken by bystanders are crucial and timely first aid appears to reduce the severity of injuries.<sup>9</sup> As such, the American Heart Association recommends mandatory CPR training for students.<sup>10</sup> First aid training may be implemented in schools due to legislative requirements, although this is not always the case. Australian schools have procedures which require them to have designated first aid personnel and available equipment; however, there is no state legislation requiring students to be trained in first aid. This is despite recommendations from key first aid bodies such as the Red Cross.<sup>11</sup> In comparison, some 36 states in the US require CPR training in schools.<sup>12</sup> This review does not explore the legal requirements of first aid training in schools, as the focus of this research is on comparing individual school-based first aid programs rather than on comparing legislative policy. However, it should be considered that the motive for including first aid in schools may differ between studies.

Plant and Taylor<sup>13</sup> conducted a broad literature review examining teaching CPR to school children, searching for “CPR,” “schools,” and “education.” The authors provided a comprehensive overview of key components relating to student factors and training factors. Student factors of age and physical aspects related to ability to perform CPR. The review highlighted differences in training factors including, the role of practical training, delivery methods, trainer type, and inclusion of Automated External Defibrillation (AED) training. The authors concluded that CPR can be successfully delivered to a wide age range of school children; that students can retain skills and knowledge (2 months to 5 years); and that repeated learning improves CPR performance.

The current review identifies published evidence that evaluates the implementation and impact of broadly-based first aid training programs, which may or may not include CPR, for adolescents within a school setting and builds on the work of Plant and Taylor.<sup>13</sup> This review is particularly concerned with understanding the depth and complexity of the training required to promote change in knowledge, skills, and behavior. To meet this objective, the current review considers the published literature regarding the breadth of training delivered and components of first aid content that are age appropriate and relevant to this developmental stage. The review also identifies process and delivery strategies including duration, resources, method of delivery, teaching styles, and trainer support. This review examines potential injury prevention outcomes, the extent to which program effectiveness, including measures of first aid knowledge, skills and behavior, and the reliability and validity of such measures have been considered.

## **METHODS**

## **Eligibility Criteria**

Studies were eligible for inclusion if they were school-based research programs targeting 10-to-18 year-olds. The inclusion criteria were pre-defined and finalized prior to the search. Each article described a first aid intervention or program in the English language. Given the limited studies, we included randomized control trials (RCTs), pre- and post-test designs, and intervention and comparison group designs. Outcome measures included attitudes, knowledge and/or behavior. As first aid training can be broadly operationalized, articles were included that described one or more aspects of first aid training, CPR, AED, emergency response training, or BLS skills. Secondary reports and editorials were excluded.

## **Data Sources and Searches**

The review was conducted using online databases, for peer-reviewed publications available as at August, 2014. Using an iterative approach, the search strategy included the keywords presented in Table 1 within the following databases PsycINFO, ERIC, Science Direct, SafetyLit, MEDLINE, CINAHL, and Proquest Education and Psychology. The references of identified articles were searched for citations. Reviews were searched for original sources.

## **Data Synthesis and Quality Assessment**

The titles and abstracts identified in the data search were screened to assess adherence to the search criteria. Where the abstract did not provide sufficient information, the full text was screened to determine inclusion. The data synthesis process was carried out by the first and second authors to ensure that relevant publications were included based on the inclusion and

exclusion criteria. Twenty articles met the inclusion criteria and are considered in the review. The two reviewers independently assessed each article for internal validity based on the study design, sample size and outcome measurement. There were only minor discrepancies and these were resolved through discussion, no formal reliability tests were conducted.

## **RESULTS**

Based on the search strategy described, 127 articles were initially identified. A broad range of general first aid articles were retrieved and as a result articles were excluded on the basis of their lack of relevance to the selection criteria. In this stage duplicates and studies that presented the first aid literature more broadly were excluded. For example, studies that aimed to increase adult bystander CPR. Sixty-five articles were excluded on the basis of the title and abstract review. For example, studies that examined knowledge without testing an intervention. Of the 42 excluded articles based on the full paper review, the primary reasons for exclusion included: no intervention or insufficient information about the evaluation (N = 16), pilot programs where the subsequent larger trial was included (N = 2), the full text was not in English (N = 3), participants were outside target age (N = 7), letters to editors (N = 8), the outcomes were not relevant (N = 5), and poor method quality (N = 1).

Following the screening process 20 peer-reviewed articles were included in the data extraction. There was little systematic research into the effectiveness of first aid training for school-aged students and the majority focused on CPR. Interventions that were not evaluated with a control group (N = 10) were included due to the limited number of studies. One RCT was identified. In the majority of the studies reviewed (N = 18), subject ages ranged between

10 and 16 years. One study examined students aged 15 to 19 years<sup>14</sup> and another examined students aged 9 to 18 years.<sup>15</sup>

## **Study Characteristics**

### **Critical limitations in design**

There were a number of limitations in terms of the research design, study sample, information provided, measures, and theoretical framework. Random allocation was not evident in many of the studies.<sup>7,8,14,16-19</sup> Ten studies had no comparison group.<sup>4,7,8,15,17-22</sup>

Limitations in sampling included the use of only one school or a small sample,<sup>14,16,18,20,22,23</sup> and in some studies the sample was comprised of all girls,<sup>23</sup> or a large proportion of girls.<sup>20</sup> One study reported a drop out rate of 72%.<sup>22</sup> In several studies limited or insufficient program information was provided.<sup>23,24</sup> In one study, no information relating to the trainer was given.<sup>19</sup> Three studies provided no information regarding timeframe for follow-up assessment.<sup>23,25,26</sup> In one study there was no information about the program duration,<sup>27</sup> and in 2 studies the number of schools was not given.<sup>8,21</sup>

In terms of assessment, only one study reported on the reliability of the evaluation measures,<sup>25</sup> and few studies used standardised checklists to assess CPR performance.<sup>15,24</sup> No studies reported on students' previous first aid experience. The majority of studies used aggregate data as opposed to case-matched data. No studies discussed the implications associated with school-based delivery or described issues regarding the possible constraints on classroom time or the availability of resources.

## **Content**

We were interested in the relevance of content to the developmental age group. However, few papers provided a justification for the inclusion of specific first aid content. A large proportion of the studies reviewed (N = 15) were limited to teaching BLS, CPR and AED skills. One intervention was specifically designed for adolescents living in farming communities, in this case students were taught by their peers about potential farm hazards, how to access emergency health care in rural communities, first aid material, and strategies to reduce injury and illness in a rural setting.<sup>14</sup>

One study covered a broad range of first aid content which included the initial emergency response (assessing the situation, checking airway, breathing, and consciousness), cardiac arrest, epileptic seizures, head/ neck injuries, burns, internal bleeding, obstructed airways, and drowning.<sup>25</sup> Another included content relating to a broken tooth, nose bleeding and paediatric BLS.<sup>21</sup> The Injury Minimization Programme for Schools (IMPS) program targeted BLS and CPR training in combination with road safety, accidents in the home, fire, electricity, poisons, and waterway dangers messages.<sup>27</sup>

## **Duration**

Ten studies reported on programs that were less than 3 hours in duration and were single sessions. A few studies described courses of one hour or less<sup>4,22,28</sup> and 4 studies examined 2-hour CPR courses.<sup>8,16,24,26</sup> Several studies described 3-hour courses.<sup>7,18,29</sup> Seven studies described programs longer than 3 hours in duration.<sup>14,15,17,19-21,30</sup> In 2 studies limited information was provided on duration.<sup>23,25,27</sup>

## Resources and Materials

The use of teaching resources and materials varied widely, however the use of mannequins<sup>4,8,15,17,29,30</sup> or mannequins plus videos was common.<sup>7,16,18,19,26</sup> One evaluation of students BLS knowledge involved the use of a mannequin, defibrillator, and telephone to demonstrate phoning emergency services.<sup>24</sup> One study taught students CPR by comparing the use of an interactive computer course with games, a video, or a mannequin,<sup>28</sup> and another compared the use of a mannequin to low-cost equipment such as a foam dice and plastic bag.<sup>22</sup> Several studies incorporated the use of manuals or textbooks,<sup>14,25</sup> and one also included a video.<sup>27</sup> Another study compared the use of static pictures of a video to teach students BLS or CPR skills.<sup>20</sup> No description of teaching resources or materials was given in one study,<sup>21</sup> and no materials were used in one study.<sup>23</sup>

## Method of Delivery

Studies largely included a combination of practical and didactic components. Two studies<sup>16,26</sup> evaluated a single course which included theoretical CPR training, a short video demonstrating a child performing CPR, practical demonstrations, and teacher feedback. Similarly, studies described the use of didactic components, theoretical lectures and practical demonstrations.<sup>4,7,8,14,15,17,18,21,24,30</sup> One study described a single lesson course which included a computer presentation of material and additional practical training in CPR.<sup>29</sup> One study included instruction and demonstration by either a teacher or video and practice sessions of compression and ventilation.<sup>22</sup> Another study evaluated a CPR course involving a DVD combined with demonstrations and hands-on training using a mannequin.<sup>19</sup>



One study compared the use of static pictures to a video, in teaching BLS to students.<sup>20</sup> In addition to incorporating practical and didactic components, the IMPS included a video about common accidents, and an emergency department tour.<sup>27</sup> One unique study compared a control group to 3 variations of a CPR course: (1) interactive computer course with games; (2) interactive computer course plus hands-on CPR and AED practice led by medical students; and (3) video demonstrating CPR and AED, teacher demonstration on a mannequin and instructor led hands-on practice.<sup>28</sup> In 2 studies limited information was provided on the use of practical components.<sup>25,27</sup>

### **Facilitator**

The type of facilitator varied widely; however, there did not appear to be a pattern related to student outcomes. In 4 studies, the facilitators included a combination of teacher and healthcare professionals.<sup>17,28-30</sup> Three studies were facilitated by healthcare professionals only.<sup>8,21,24</sup> In 6 studies training was facilitated by teachers.<sup>7,15,16,18,25,27</sup> Two studies used a form of peer training models, which involved high school students being instructed to facilitate the training to their peers.<sup>14,26</sup> One study compared the delivery of BLS material by either a teacher or a video.<sup>22</sup> One study describing online training did not require a facilitator,<sup>23</sup> and in 2 studies the facilitator was not reported.<sup>4,19</sup>

The support given to trainers varied extensively. One study examined a Train-the-Trainer model, high school students were trained in first aid and in delivering material prior to teaching first aid skills and risk reduction to peers.<sup>14</sup> In one study a single teacher with no formal certification facilitated all lessons, however prior to the intervention she was required to complete a 1.5 hour training regarding the program implementation.<sup>20</sup> In 6 studies teachers

received training in CPR or BLS by trained instructors or physicians, ranging from one hour to 2 days.<sup>7,15,17,18,24,29</sup> Studies examining the ABC for Life Program involved medical students instructing teachers who then instructed students.<sup>16,26</sup> In one study teachers were provided with a program education resource pack which included extensive teaching materials, however no further training was provided.<sup>27</sup>

### **Assessment**

All but one study assessed knowledge using a multiple-choice survey. The length of the measures ranged from 10 items<sup>17</sup> to 53 items.<sup>25</sup> In addition to a multiple-choice survey, one study also included short answer responses.<sup>23</sup> Many studies used mannequins to enable practical assessment of CPR skills.<sup>4,7,8,18,23,24,28,29</sup> Two studies described the use of a mannequin and skill reporting software to assess students CPR performance.<sup>20,22</sup> One study used a simulated phone to assess students' ability to make an emergency call, in addition to a standardised checklist for assessing CPR skills.<sup>15</sup>

### **Key Outcomes**

There is generally positive support for improvement in knowledge, skills and retention of first aid, BLS and/or CPR material following school-based interventions. In one study, following the training intervention students' knowledge relating to CPR significantly improved by 20%, in comparison to a 5% improvement by control students.<sup>29</sup> The systematic search did not an association between the frequency of training or trainer type with CPR performance. Several studies reported similar improvements in knowledge scores following training, and compared to control groups.<sup>24,26</sup>

Many studies reported significant improvements in knowledge and retention of information up to 12 months post-intervention.<sup>4,8,15,17,19,27,28,30</sup> Connolly et al<sup>16</sup> reported that after 6 months, improvement in CPR knowledge declined from initial follow-up, but was still significantly higher than baseline and there were no improvements for control students.

Several articles found mixed results for the effectiveness of the first aid programs on the outcomes assessed. Carruth et al<sup>14</sup> reported a significant increase in intervention students' anticipatory action in an emergency situation post-test compared to controls; however no significant differences in knowledge were found. When comparing classes that implemented the program (poor uptake) to the control group, Engeland et al<sup>25</sup> reported significant differences in some knowledge items. Differences were found in items relating to how casualties suffering from shock should be placed, whether one should give sugar to a person losing consciousness due to diabetes, and what to do with a person having a serious epileptic seizure. In another study Teague and Riley<sup>23</sup> reported significant change in knowledge compared to the control group but no significant change in CPR performance. Iserbyt et al<sup>20</sup> reported no significant differences in chest compression depths between students who received a picture only intervention and students who received a video only intervention.

### **Comprehensive Programs**

Whereas there were few rigorous evaluations identified, 3 programs were comprehensive and included content that was relevant to the target group. Carruth et al<sup>14</sup> delivered 11 modules comprising of introduction to farm hazards, considering how to access emergency health care in rural communities, first aid content, and strategies for reducing injury/illness. This program used relevant content specific to the context of living in farming communities

and unlike many other programs reviewed it included training for facilitators. The authors found significant increases in anticipatory action and greater knowledge post-intervention. Limitations of this evaluation included a short follow-up period, small sample size (N = 43), one school only and no random allocation.

Fleischhackl et al.<sup>15</sup> examined the impact of BLS training on 147 students from 11 randomly selected schools. Teachers delivered a 6-hour course which included material describing the use of an AED, providing CPR and treating life-threatening bleeding. The course comprised didactic sessions as well as hands on training using mannequins. Classes spanned a time period of 3 months and all students were trained by the Austrian Youth Red Cross to the level of a BLS instructor using a standardized curriculum. At 4 months post-intervention, students demonstrated retention of knowledge and indicated that they had successfully and effectively learned BLS skills including the use of an AED. A limitation of this study was the lack of a comparison group and pre-test scores.

An evaluation of the IMPS program conducted by Frederick et al.<sup>27</sup> included 1292 students. The program was delivered by teachers within school curriculum and targeted road safety, accidents in the home, fire, electricity, poisons and waterways, as well as BLS and CPR training, a video about common accidents and a tour of a hospital emergency department. Teachers were provided with an IMPS education resource pack which includes extensive teaching materials. Data were matched from baseline to 5 months follow-up and showed significant increases in knowledge. A limitation of this study was in the ability to randomly allocate as some schools were already enrolled in the program and analyses did not account for possible school-level effects.

## **Injury Prevention Outcomes**

Injury prevention outcomes were described in 2 studies included in the review. Self-report focus group data reported by Carruth et al<sup>14</sup> indicated students' awareness of safety issues and farm risks increased. Students discussed adjusting work practices to prevent injuries such as not wearing appropriate footwear on the farm, and commented on their intention to change unsafe practices. An evaluation of the IMPS indicated that intervention students' knowledge relating to accidents in the home, electricity safety, fire safety, emergency phone number, water safety, poison recognition, pedestrian safety, burns first aid and choking first aid compared to their baseline scores. Intervention students were more likely to encourage others to stop doing something dangerous and to respond to the situation by phoning emergency services. Both teachers and parents reported that the intervention had been successful in raising students' awareness of safety issues.<sup>27</sup> Whereas 2 studies touch upon injury prevention issues, they did not measure injury reduction.<sup>14,27</sup>

## **DISCUSSION**

There are a substantial number of first aid/CPR programs being delivered to adolescents at school and there is considerable variation in the program and study designs (including lack of comparison group). School-based first aid programs typically target early- to mid-adolescents, however studies rarely provide a rationale for the selection of a particular target group. Only one study used a RCT design.

In terms of program duration, research supported programs with longer durations that included both practical and didactic components.<sup>27</sup> A number of studies that contained at least 3 hours of lesson time reported significant improvements in knowledge and retention of information, ranging from 3 to 12 months post-intervention.<sup>15,17,19,30</sup> There were, however,

shorter programs that demonstrated significant changes in knowledge 4 to 6 months post-intervention.<sup>8,24</sup>

In terms of the facilitator and method of delivery, one study reported that neither more frequent training nor training by emergency physicians, as opposed to teachers, led to better CPR performance among the students.<sup>29</sup> Yet, it is difficult to disaggregate which components of the program are associated with positive change. Nonetheless, the value of incorporating both practical and didactic components indicates that this is an important factor in both the delivery of material and in facilitating the retention of knowledge. Learning materials such as mannequins, videos and accredited first aid booklets, and facilitator training were found to be common features of effective programs.<sup>7,15,17,18,24,29</sup> As many jurisdictions require teachers, such as health and physical education teachers, to be trained and certified in first aid/CPR, this research supports that they are appropriate guides to train students. In previous research health teachers have commented that they see themselves as having positive relationships with students.<sup>31</sup>

This review indicates that there are benefits to incorporating context specific and developmentally appropriate material. Whereas the majority of studies included were limited to teaching BLS, CPR and AED skills some programs targeted issues relating to common and serious injuries experienced by this developmental age group. Further, 2 programs integrated issues concerning injury prevention in which students reported adjusting work practices to prevent injuries and commented on their intention to change unsafe practices.<sup>14,27</sup>

The evaluation of the IMPS program provided support for the inclusion of first aid training, injury prevention and safety awareness material in school curriculum. It revealed that following the program students had significant improvements in related knowledge and

were more likely to encourage others to stop doing something dangerous.<sup>27</sup> Although 2 studies touched upon injury prevention issues they did not measure whether there was a reduction in injuries over time and whether this effect was sustained.<sup>14,27</sup> The inclusion of injury prevention components and discussion about injury experience indicates that first aid training may increase the saliency of injury outcomes and increase safer practices. There is evidence which shows that when training in first aid/CPR, may reduce injuries,<sup>32</sup> suggesting that these effects may transfer to the school setting.

Of the 20 studies that have examined the effectiveness of first aid training there have been few thorough evaluations. Some inconsistencies in the results highlight the importance of ensuring that rigorous evaluations are conducted and particularly the need for future research in this area to conduct RCTs. Further, a number of researchers have highlighted the importance of developing program material that is personally relevant to subjects and context specific to the target group.<sup>33,34</sup>

## **Conclusions**

This paper offers a systematic review exploring school-based first aid interventions to understand the breadth of training delivered to students and the broader components of first aid that are age appropriate and context specific to the adolescent developmental age group. The review highlights that, at least in the short term, a variety of approaches to training in first aid and CPR skills are effective in increasing students' knowledge and skills, and therefore are perceived by students' as being relevant and interesting. Training interventions should be longer than 3 hours in duration, include both practical and didactic components, contain well designed resources, and require training for facilitators. Educational resources

should be age appropriate and context specific. Further research is warranted in relation to the benefits of first aid knowledge for injury prevention.

## **IMPLICATIONS FOR SCHOOL HEALTH**

The current review provides support for the inclusion and feasibility of first aid training in high school curriculum. Through this research process there are a number of critical components that were identified and will assist future researchers participating in school-based research and program evaluation, as well as schools interested in implementing first aid training in curriculum. Particularly, it is important to consider whether schools have the available resources to implement and sustain the program. When implementing first aid training programs in the school curriculum particular attention should be paid to ensuring the content is relevant to the target group, incorporates practical/interactive components to complement didactic teaching, utilises appropriate and relevant resources, provides facilitator training. Factors such as the legal obligation for schools to include first aid training in their curriculum is likely to impact on the feasibility of implementing school-based training and should be considered in future research.

Our results suggest that first aid may potentially have protective benefits for adolescents. First aid training is intended, among other educational aims, to increase the saliency of injury outcomes and consequently reduce injury by using hands on training and discussion about injury experiences. This assumption is supported by earlier research which has shown that first aid training may reduce the likelihood of injury.<sup>32</sup> As research progresses, it is important that these relationships continue to be explored as they potentially have significant implications for adolescent injury prevention and control. Based on research highlighting the



high rates of adolescent injury, it is essential that as part of their health education young people are aware of potential risks as well as strengths that they have to monitor their own or their peers injuries. First aid and emergency response along with peer protection is a key element to such health education.

### **Human Subjects' Approval Statement**

This study was approved by the Queensland University of Technology – University Human Research Ethics Committee (Approval number: 1100000744).

### **ACKNOWLEDGEMENTS**

We acknowledge financial support from the Australian Research Council (ARC-DP, DP110105043).

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## REFERENCES

1. Peden M., Oyegbite K, Ozanne-Smith J, Hyder A, Branche C, Rahman A, et al. eds.. *World Report on Child Injury Prevention*. Geneva, Switzerland: World Health Organization; 2008. Available at: [http://whqlibdoc.who.int/publications/2008/9789241563574\\_eng.pdf](http://whqlibdoc.who.int/publications/2008/9789241563574_eng.pdf). Accessed 11 July 2013.
2. Maitra A. School accidents to children: time to act. *J Accid Emerg Med*. 1997;14(4):240-242.
3. Uray T, Lunzer A, Ochsenhofer A, Thanikkel L, Zingerle R, Lillie P, et al. Feasibility of life-supporting first-aid (LSFA) training as a mandatory subject in primary schools. *Resuscitation*. 2003;59(2):211-220.
4. Kelley J, Richman P, Ewy G, Clark L, Bullock B, Bobrow B. Eighth grade students become proficient at CPR and use of an AED following a condensed training programme. *Resuscitation*. 2006;71(2):229-236.
5. Glendon A, McKenna S. Using accident injury data to assess the impact of community first aid training. *Public Health*. 1985;99(2):98-109.
6. Lingard H. The effect of first aid training on Australian construction workers' occupational health and safety motivation and risk control behavior. *J Saf Res*. 2002;33(2):209-230.
7. Lester C, Donnelly P, Weston, C. Is peer tutoring beneficial in the context of school resuscitation training? *Health Educ Res*. 1997;12(3):347-354.

8. Meissner T, Kloppe C, Hanefeld C. Basic life support skills of high school students before and after cardiopulmonary resuscitation training: a longitudinal investigation. *Scand J Trauma Resusc Emerg Med.* 2012;20:31-38.
9. Hussain L, Redmond A. Are pre-hospital deaths from accidental injury preventable? *Brit Med J.* 1994;308(6936):1077-1080.
10. Cave D, Aufderheide T, Beeson J, Ellison A, Gregory A, Hazinsky M, et al. Importance and implementation of training in cardiopulmonary resuscitation and automated external defibrillation in schools: a science advisory from the American Heart Association. *Circulation.* 2011;123(6):691–706.
11. Australian Red Cross. Red Cross calls for compulsory first aid training in schools. Available at: <http://www.redcross.org.au/red-cross-calls-for-compulsory-first-aid-training-in-schools.aspx>. Accessed March 13, 2015.
12. American Heart Association. CPR in Schools Legislation. Available at: [http://www.heart.org/HEARTORG/CPRAndECC/CommunityCPRandFirstAid/CPRinSchools/States-CPR-Regulations-for-Schools\\_UCM\\_470097\\_SubHomePage.jsp](http://www.heart.org/HEARTORG/CPRAndECC/CommunityCPRandFirstAid/CPRinSchools/States-CPR-Regulations-for-Schools_UCM_470097_SubHomePage.jsp). Accessed March 13, 2015.
13. Plant N, Taylor K. How best to teach CPR to schoolchildren: a systematic review. *Resuscitation.* 2012;84(4):415-421.
14. Carruth A, Pryor S, Cormier C, Bateman A, Matzke B, Gillmore K. Evaluation of a school-based train-the-trainer intervention program to teach first aid and risk reduction among high school students. *J Sch Health.* 2010;80(9):453-460.

15. Fleischhackl R, Nuernberger A, Sterz F, Schoenberg C, Urso T, Habart T, et al. School children sufficiently apply life supporting first aid: a prospective investigation. *Crit Care*. 2009;13(4):127.
16. Connolly M, Toner P, Connolly D, McCluskey D. The 'ABC for life' programme – teaching basic life support in schools. *Resuscitation*. 2007;72(2):270-279.
17. Jiménez-Fábrega X, Escalada-Roig X, Miro O, Sanclemente G, Diaz N, Gomez X, et al. Comparison between exclusively school teacher-based and mixed school teacher and healthcare provider-based programme on basic cardiopulmonary resuscitation for secondary schools. *Emerg Med J*. 2009;26(9):648-652.
18. Lester C, Donnelly P, Weston C, Morgan M. Teaching schoolchildren cardiopulmonary resuscitation. *Resuscitation*. 1996;31(1):33-38.
19. Naqvi S, Siddiqi R, Hussain S, Batool H, Arshad H. School children training for basic life support. *J Coll Physicians Surg Pak*. 2011;21(10):611-615.
20. Iserbyt P, Charlier N, Mols L. Learning basic life support (BLS) with tablet PCs in reciprocal learning at school: are videos superior to pictures? A randomized control trial. *Resuscitation*. 2014;85(6):809-813.
21. Lubrano R, Romero S, Scoppi P, Cocchi G, Baroncini S, Turbacci M, et al. How to become an under 11 rescuer: a practical method to teach first aid to primary schoolchildren. *Resuscitation*. 2005;64(3):303-307.
22. Raemdonck V, Monsieurs K, Aerenhouts D, De Martelaer K. Teaching basic life support: a prospective randomized study on low-cost training strategies in secondary schools. *Eur J Emerg Med*. 2014;21(4):284-290.

23. Teague G, Riley R. Online resuscitation training. Does it improve high school students' ability to perform cardiopulmonary resuscitation in a simulated environment? *Resuscitation*. 2006;71(3):352-357.
24. Younas S, Raynes A, Morton S, Mackway-Jones K. An evaluation of the effectiveness of the Opportunities for Resuscitation and Citizen Safety (ORCS) defibrillator training programme designed for older school children. *Resuscitation*. 2006;71(2):222-228.
25. Engeland A, Røysamb E, Smedslund G, Sjøgaard A. Effects of first-aid training in junior high schools. *Int J Inj Contr Saf Promot*. 2002;9(2):99-106.
26. Toner P, Connolly M, Lavery L, McGrath P, Connolly D, McCluskey D. Teaching basic life support to school children using medical students and teachers in a 'peer-training' model - Results of the 'ABC for life' programme. *Resuscitation*. 2007;75(1):169-175.
27. Frederick K, Bixby E, Orzel M, Stewart-Brown S, Willett K. An evaluation of the effectiveness of the Injury Minimization Programme for Schools (IMPS). *Inj Prev*. 2000;6(2):92-95.
28. Reder S, Cummings P, Quan L. Comparison of three instructional methods for teaching cardiopulmonary resuscitation and use of an automatic external defibrillator to high school students. *Resuscitation*. 2006;69(3):443-453.
29. Bohn A, Van Aken H, Mollhoff T, Wienzek H, Kimmeyer P, Wild E, et al. Teaching resuscitation in schools: annual tuition by trained teachers is effective starting at age 10. A four-year prospective cohort study. *Resuscitation*. 2012;83(5):619-625.

30. Jiménez-Fábrega X, Escalada-Roig X, Sanchez M, et al. Results achieved by emergency physicians in teaching basics cardiopulmonary resuscitation to secondary school students. *Eur J Emerg Med.* 2009;16(3):139-144.
31. Chapman R, Buckley L, Shochet I. Pilot evaluation of an adolescent risk and injury prevention programme incorporating curriculum and school connectedness components. *Health Educ Res.* 2013;28(4):612-625.
32. Buckley L, Sheehan M, Chapman K. The inclusion of first aid in an injury prevention curriculum. Proceedings of the 26th Australasian Council of Health, Physical Education and Recreation International Conference, 7-10 July 2009, Queensland University of Technology, Brisbane, Queensland. Available at: <http://eprints.qut.edu.au/27944/>. Accessed January 3, 2016. [Abstract]
33. Perry C. *Creating Health Behaviour Change: How to Develop Community-Wide Programs for Youth.* Thousand Oaks, CA: Sage; 1999.
34. Sussman S, Rohrbach L, Patel R, Holiday K. A look at interactive classroom-based drug abuse prevention program: interactive contents and suggestions for research. *J Drug Educ.* 2003;33(4):355-368.

Table 1. **Key Search Phrases**

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Key phrases
school OR educat* OR instruct* OR kindergarten OR student OR chil* OR adolescen* OR teen* OR youth
AND
first aid OR cardiopulmonary resuscitation OR CPR OR automated external defibrillation OR AED OR life support OR basic life support OR emergency treatment OR emergency response OR life saving skills OR bystander trauma care OR bystander response OR prehospital management
AND
interven* OR program* OR train* OR teach* OR learn* OR evaluat* OR prevent*

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