Knowledge and attitude of Singapore schoolchildren learning cardiopulmonary resuscitation and automated external defibrillator skills

Phek Hui Jade Kua1, MBBS, MRCS, Alexander E White2, JD, MPH, Wai Yee Ng3, BSc, Stephanie Fook-Chong4, MSc, CStat, Eileen Kai Xin Ng5, BN, Yih Yng Ng5, MBBS, MPH, Marcus Eng Hock Ong6,7, MBBS, MPH

1Department of Emergency Medicine, KK Women’s and Children’s Hospital, 2Unit for Pre-hospital Emergency Care-Policy, 3Health Services Research, Division of Research, Singapore General Hospital, 4Centre for Quantitative Medicine, Duke-NUS Medical School, 5Medical Department, Singapore Civil Defence Force, 6Department of Emergency Medicine, Singapore General Hospital, 7Health Services and Systems Research, Duke-NUS Medical School, Singapore

Correspondence: A/Prof Marcus Eng Hock Ong, Senior Consultant, Department of Emergency Medicine, Singapore General Hospital, Outram Road, Singapore 169039. marcus.ong.e.h@singhealth.com.sg

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ABSTRACT

Introduction: Victims of out-of-hospital cardiac arrests require timely cardiopulmonary resuscitation (CPR) and early defibrillation. Persons making the call to emergency medical services will be asked to provide dispatcher-guided response until an ambulance arrives. Knowing what to expect in such circumstances should reduce both delay and confusion.

Methods: We conducted this study among schoolchildren aged 11–17 years using ten-item pre- and post-training surveys. In this study, we aimed to observe any knowledge and attitude shift regarding CPR and automated external defibrillator (AED) use subsequent to the training.

Results: A total of 1,196 students across five schools completed the pre- and post-training surveys. Survey questions tested basic CPR knowledge and probed about attitudes toward CPR and AED use. The overall response rate was 80.8% and 81.5% in the pre- and post-training surveys, respectively. There was statistically significant improvement in the students’ CPR knowledge. The number of students who selected all correct answers for the knowledge-based questions in the post-training survey increased by 64.7% (95% confidence interval 61.9%–67.5%; p < 0.001). There was also improvement in willingness to administer CPR (likely/very likely to administer CPR pre-training vs. post-training: 13.0% vs. 71.4%; p < 0.001) and use AED (likely/very likely to administer AED pre-training vs. post-training: 11.7% vs. 78%; p < 0.001) after training.

Conclusion: The training imparted new information, skills and improved attitudes toward providing CPR and using AED. However, some concerns about hurting the victim while performing CPR persisted.

Keywords: AED, cardiac arrest, CPR, school, training
INTRODUCTION

Cardiopulmonary resuscitation (CPR) skills and the willingness to act can be taught and engrained at an early age. Several cities and countries have successfully done this.\(^1\) Teaching schoolchildren CPR and automated external defibrillator (AED) use are considered important components to any locale’s strategy to increase the out-of-hospital cardiac arrest (OHCA) survival rate. There is a correlation between OHCA survival rate and the bystander CPR rate,\(^6\)\(^-\)\(^9\) and an even stronger link with the quality of the bystander CPR.\(^10\) In Singapore, the bystander CPR rate had plateaued at just over 20% and remained at this level for many years.\(^11\) Motivated local physicians developed a training programme to help increase the bystander CPR rate,\(^12\) and in this way, close the gap between Singapore and other countries that are considered leading models for good OHCA survival rates.

Compared to Singapore (11%),\(^11\) Europe\(^13\) has a greater OHCA survival rate (median 23.3% for witnessed shockable rhythm arrests). Such high rates are attributable to various pre-hospital improvements and public training initiatives.\(^14\)\(^-\)\(^18\) Pertinent to our study, Norway,\(^19\)\(^-\)\(^21\) Sweden\(^14,17\) and Denmark,\(^15\) for example, have successfully mandated various school-based CPR and AED trainings over the years as part of their overall strategy to improve OHCA survival outcomes.\(^5,15,19\)\(^-\)\(^21\) The success in Europe and Seattle\(^22\) inspired Singapore to adopt a multifaceted approach to improve bystander CPR rates.

This study focused on the implementation of the first school-based training curriculum piloted in Singapore. School-based training is an effective and sustainable method used to train large numbers of future adult members of society.\(^5,22\) Recently, the World Health Organization (WHO) endorsed the ‘Kids save lives’ joint statement, which postulates that an effective method of improving bystander CPR is to provide training in schools.\(^23\) In the present study, we aimed to measure, assess and report any immediate knowledge gain and attitude shifts experienced by students attending the training.
METHODS
We created a training programme named DARE, which stands for Dispatcher-Assisted first REsponder. DARE is a 45-minute programme consisting of a 13-minute video, and hands-on practice of CPR and the use of AED on a manikin. The programme’s core teaching points are to: (a) immediately call 9-9-5 for an ambulance and staying on the line; (b) do chest compressions by pushing hard and fast on the centre of the chest; and (c) direct someone to get an AED and use it.

Since Singapore has a dispatcher-assisted CPR protocol, the trainer role-played as a dispatcher during the hands-on section of the training session. This dispatcher role was central to the simulation training. The training familiarised students with the dispatcher’s instructions, which are usually given during a real-life OHCA call and the actions that the caller would be asked to perform.

Training was designed to keep schoolchildren and young people engaged. The video was scripted to be humorous at times while conveying information on a very serious subject. The actors included schoolchildren and a popular contemporary Singapore actor. The video content was divided into various chapters, beginning with an introductory stage play, where the main character collapsed from a cardiac arrest and the children, aided by the dispatcher, successfully resuscitate him. Afterwards, the video delved into the pathophysiology of a cardiac arrest using layman’s terms and animation for easy comprehension. The video then took on a heart-warming note, when an actual OHCA survivor and his rescuers shared their real-life story to inspire and motivate the audience.

After the video, students were split into small groups to begin the hands-on training. Small group configurations enhance skills-learning by allowing facilitators to easily observe and work with students on proper technique and skills implementation. During the hands-on segment, students were taught to dial the emergency medical number, to put the dispatcher on
speaker before placing the phone near the victim’s head, to perform chest compressions and to use the AED safely.

This study was conducted in Singapore, with approval from SingHealth Centralised Institutional Review Board (CIRB) at Singapore General Hospital (SGH; CIRB Ref 2013/1020/E).

Our study cohort included five schools: one primary (elementary school; School A); two secondary (junior high schools; Schools B and C); and two junior colleges (high schools; Schools D and E). Students were in the age group of 11–17 years. All students from one secondary school and the primary school were girls. The remaining three schools had gender-balanced participation. One school specialised in teaching students with learning challenges. All schools had a racial mix (students were ethnically Chinese, Malay or Indian) representing the main ethnic groups in Singapore.

Two of five schools (Schools C and D) completed the surveys electronically by accessing it on Google Docs using smartphones at the training site; the others responded using paper surveys. Pre- and post-training questionnaires (see Appendices A and B, respectively) contained ten questions across two sections. Section 1 consisted of five questions (Questions 1–5) designed to assess students’ acquired knowledge on CPR and AED. Section 2 consisted of four questions (Questions 6–9) to assess students’ shift in attitudes and beliefs about CPR and AED use. An additional question (Question 10) asked about their preferred method of CPR/AED instruction, assessing what they thought they would like to have in a training session (before the intervention) and what they liked about the training after experiencing it.

The 45-minute training programme was the assessed intervention. Pre- and post-training surveys were conducted using the same questionnaire on the same group of students from these five schools to assess facets of the training programme. The anonymous pre- and post-training surveys were matched using a unique student identifier. Assessed outcomes
included changes in student knowledge of CPR and AED use (Questions 1–5), and attitudes toward CPR and AED use (Question 6–9). Question 10 assessed the students’ expectations from the CPR/AED training programme and their assessment of it after attending it. Unanswered questions were treated as missing values and the results reported were based on valid responses.

To assess the level of pre- and post-training knowledge about CPR and AED use, the proportions of students correctly answering each of the five knowledge questions were calculated. McNemar’s chi-square test was used to determine whether there was statistically significant improvement in knowledge pre-training versus post-training. The overall difference in pre- and post-training knowledge was determined by calculating the total number of students who answered all five questions correctly. McNemar’s test was also used to compare the overall difference between the pre- and post-training knowledge assessments. For these data, 95% confidence intervals (CIs) were presented.

The proportion of the types of attitudes/beliefs about CPR/AED use was calculated for Questions 6–9 for both the pre- and post-training surveys. Due to small numbers, the ‘very likely’ and ‘likely’ responses, and ‘unlikely’ and ‘very unlikely’ responses were grouped together, respectively, for Question 6 and Question 8 to determine the proportion of students who were likely or unlikely to perform CPR/AED use on a collapsed person. McNemar’s test was also used to compare the overall difference between the pre- and post-training attitudes and beliefs. Here, too, 95% CIs were calculated. A p-value < 0.05 on the McNemar’s test for the survey findings was considered to be statistically significant. All tests were two-tailed. Data was analysed using Stata version 13.0 (StataCorp, College Station, TX, USA).
RESULTS

Overall, 1,196 students participated in the survey. The majority of the participants were girls. The overall mean age of the students was 14 years. The overall response rate was 80.8% for the pre-training survey and 81.5% for post-training. The response rates, by school, are presented in Table I.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall (n = 1,196)</th>
<th>School A (n = 261)</th>
<th>School B (n = 45)</th>
<th>School C (n = 325)</th>
<th>School D (n = 499)</th>
<th>School E (n = 66)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (yr)</td>
<td>14</td>
<td>11</td>
<td>11</td>
<td>15</td>
<td>17</td>
<td>17</td>
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<td>Response rate (%)</td>
<td>80.8</td>
<td>82.3</td>
<td>42.1</td>
<td>100.0</td>
<td>85.9</td>
<td>81.7</td>
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<tr>
<td>Pre-training survey</td>
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<tr>
<td>Post-training survey</td>
<td>81.5</td>
<td>82.3</td>
<td>38.6</td>
<td>100.0</td>
<td>93.5</td>
<td>61.7</td>
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</tbody>
</table>

All survey questions were in multiple-choice format. Compared to only 4.2% in the pre-training survey, 68.9% of students overall answered all the knowledge-testing questions correctly in the post-training survey (Table II). Of all students surveyed, the two junior colleges produced the highest rate of perfect scores in the knowledge-testing section of the post-training survey with 42.1% combined. The two secondary schools were next with 20.8% combined, followed by the single primary school with 5.9%. School D (junior college) achieved the highest improvement in perfect scores on the knowledge-testing questions with a difference of 88.2% (95% CI 85.1%–91.2%; p < 0.001) between the pre- and post-training surveys. Conversely, School B (secondary school) improved the least between pre-training and post-training survey (pre-training vs. post-training: 0.0% vs. 11.1%, 95% CI −2.9% to 22.5%; p = 0.063).
Table II. Students who answered all knowledge-testing questions (Questions 1–5) correctly (n = 1,196).

<table>
<thead>
<tr>
<th>School</th>
<th>Students who answered all questions correctly (no. [%])</th>
<th>% difference (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-training survey</td>
<td>Post-training survey</td>
<td></td>
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<tr>
<td>All five schools</td>
<td>50 (4.2)</td>
<td>824 (68.9)</td>
<td>64.7 (61.9 to 67.5)</td>
</tr>
<tr>
<td>School A (n = 261)</td>
<td>12 (4.6)</td>
<td>71 (27.2)</td>
<td>22.6 (17.1 to 28.1)</td>
</tr>
<tr>
<td>School B (n = 45)</td>
<td>0 (0.0)</td>
<td>5 (11.1)</td>
<td>11.1 (−2.9 to 22.5)</td>
</tr>
<tr>
<td>School C (n = 325)</td>
<td>9 (2.8)</td>
<td>244 (75.1)</td>
<td>72.3 (67.1 to 77.6)</td>
</tr>
<tr>
<td>School D (n = 499)</td>
<td>27 (5.4)</td>
<td>467 (93.6)</td>
<td>88.2 (85.1 to 91.2)</td>
</tr>
<tr>
<td>School E (n = 66)</td>
<td>2 (3.0)</td>
<td>37 (56.1)</td>
<td>53.1 (39.5 to 66.6)</td>
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</table>

AED: automated external defibrillator; CI: confidence interval; CPR: cardiopulmonary resuscitation

Importantly, students improved their rate of correct responses for the safety question (Table III, Question 1), which asked what they should do first if they see someone collapse (pre-training vs. post-training: 36.6% vs. 93.8%, difference 57.2%, 95% CI 54.3%–60.1%; p < 0.001). Referring to what emergency number to call, Question 2 had the smallest margin of improvement overall (difference 26.9%) presumably because students were already familiar with the right answer. However, one school did slightly worse with Question 2 in the post-training survey (95.6%) when compared to pre-training levels (100.0%), although the difference was not statistically significant (p = 0.500). All schools showed improvement on Question 3, which asked what one should do after getting through to the dispatcher, which is a fundamental learning point in the training (pre-training vs. post-training: 56.4% vs. 97.7%; p < 0.001). Questions 4 and 5 pertained to depth and rate of compressions, respectively. Overall, the margins of improvement for these questions from pre- to post-training surveys for all schools were 54.0% and 59.6%, respectively.

In the pre-training survey, 67.0% of students from the five schools chose either ‘unlikely’ or ‘very unlikely’ to perform CPR on a collapsed person (Fig. 1). Only 13.0% selected either ‘likely’ or ‘very likely’ to perform CPR on a collapsed person while 20.0% of students “did not know”. After the training, the proportion of students who thought they were
likely or very likely to perform CPR increased by 58.0% (likely/very likely to administer CPR pre-training vs. post-training: 13.0% vs. 71.0%; p < 0.001) (Fig. 1). The top reason chosen overall (58.0%) for why students were less likely to perform CPR (Question 7a) was that they were afraid of accidentally hurting the victim (Fig. 2). The overall response rate for this question increased to 67.0% (9% increase) in the post-training survey. This increase was driven by junior college students who shifted their response from ‘never been taught what to do’ (junior colleges D and E pre-training: 40.0% and 46.7% respectively) to ‘being afraid of accidentally hurting the victim’ (post-training: 70.5% and 83.3%, respectively). Post-training, students indicated that the most important reason why they would perform CPR on a collapsed person (Question 7b) was that they had now been taught how to perform CPR (36%). Almost as many students (34%) responded that they felt it was their duty to help someone in need. Many (26%) indicated that they felt that they were more likely to help than do harm (Fig. 3).

In the pre-training survey, 86.0% of students responded that they were either unwilling to use or did not know if they would use an AED (Fig. 4). Before training, 46.0% of students chose ‘I have never been taught what to do’, and 40.0% chose ‘I am scared I might accidentally hurt the victim’ as reasons why they were less likely to use an AED (Question 9a, Fig. 5). After training, the combined percentage of students who were likely or very likely to use AED increased by 66.3% (likely/very likely to administer AED pre-training vs. post-training: 11.7% vs. 78.0%) (Fig. 4). When asked to identify the most important reason why they were likely to use AED (Question 9b), students most frequently indicated that they had been taught how to use AED (pre-training vs. post-training: 20.0% vs. 49.0%) (Fig. 6).

Fig. 7 shows that the students’ top choice for Question 10 was to have a ‘humorous video’ when learning about CPR and AED, in both the pre- (28.3%) and post-training (35.5%) surveys. The popularity of a ‘humorous video’ was followed by ‘real-life accounts’ (17.1%) in
the pre-training survey, but in the post-training survey a ‘person of authority to guide me…’ (17.3%) was the second popular most popular choice.

**DISCUSSION**

This study reported the response of schoolchildren, aged 11–17 years, to the first pilot-tested DARE trainings in the school setting. Training children is an essential component to an overall strategy of transforming a society into one that is prepared and motivated to respond to OHCA. This is especially important since OHCA is a time-sensitive emergency, of which 70% occur at home or in residential areas and are likely happen to a family member or someone known to the bystander.

Steps to improve schoolchildren’s knowledge and attitudes toward taking emergency action as a first responder is as important as teaching the physical skills involved in delivering lifesaving CPR and AED interventions. This is because if one knows how to recognise the emergency and calls the emergency medical phone number without delay, the trained dispatchers are capable of guiding even an untrained person to take lifesaving steps before the ambulance arrives. Furthermore, the caller must be willing, if capable, to follow the dispatcher’s instructions. With this training, we aimed to effect a better quality response and minimise delay by reducing the dispatcher-assisted CPR learning curve, to motivate trainees to respond quickly and ultimately, to saturate the country with generations of prepared youth for the future.

The advantages of training children in their schools are compelling. CPR/AED training in schools helps to expose a great number of people to such knowledge and skills; it also leverages a multiplying effect by teaching children, who in turn teach family members and friends. School-based training also levels the playing field among classes of society, within which are those with fewer resources to otherwise be CPR/AED-trained. Finally, school-based
training utilises the teaching environment and structure of schools for added sustainability.\(^5\)

With these advantages, implementing a training requirement in school is an important step forward toward fostering a culture of action, which has been appropriately supported in the Institute of Medicine’s recent report on cardiac arrest.\(^{24}\)

For many students, this is their first exposure to first-responder training. School-based training sensitises children at an early age to recognise a collapse and imparts the necessary sense of urgency to act right away.\(^{2,25}\) In our study, researchers had an opportunity to observe any shifts in knowledge and attitude toward CPR/AED, and to better understand what areas may need more emphasis.

Although, overall, our students gained knowledge and were more willing to perform CPR and AED to help others after training, there was lingering concern about harming the victim. This can be seen in the high pre- and post-training survey response to Question 7a, where students felt less likely to perform CPR and AED because they were scared that they ‘might accidentally hurt the victim’. Also, this could explain why secondary school students frequently selected the response, ‘I feel my duty as a bystander is just to call the ambulance and wait for help to arrive’, to the same question even in the post-training survey. This area of concern requires some more emphasis during training, so that it does not become a barrier to appropriate response, particularly if the victim should be a loved one or acquaintance. Generally, this persistent concern was observed across all school grade levels. However, interestingly, it was the older students’ shift from a pre-training response that they had not been trained to one in which they expressed concern about hurting the victim that was the main driver of the survey result we observed.

There could be two explanations for this result. One possibility is the conclusion that our training needs to emphasise more the fact that someone in cardiac arrest is more likely to be helped by CPR/AED efforts made by the bystander rather than his or her focus on
accidentally hurting the victim while attempting to help. Second may be related to survey design, wherein the answer choices the students were asked to select from influenced our findings. It is possible that especially among the older students, the increase in responses expressing this concern was the result of having few other plausible multiple-choice answer options available in the post-training survey when compared to the pre-training one. These junior college students had just trained, and so not having been taught what to do was not an option they were likely to select. Having understood the training message, dialling 9-9-5 and waiting for the ambulance’s arrival was also not a likely option many would choose. For similar reasons, older students were unlikely to indicate that they were afraid of being scolded. Given the options, for the post-training survey, the only viable remaining option to pick, apart from ‘other’, would be that they were afraid they might accidentally hurt the victim while doing CPR. We suspect that our results were a combination of both real concern regarding hurting the victim and the few post-training answer choices that were available to this relatively more mature, junior college student cohort.

Fear of harming the victim is not uncommon and was reported in another similar study.\(^{(20)}\) Indeed, this anxiety is shared by many laypeople training in basic life support and is addressed in our training video. It might be that through a deeper understanding of OHCA and the necessary trade-offs involved with CPR (e.g. broken ribs due to CPR with better chance of survival as opposed to poorer outcomes without CPR), this anxiety can be replaced with a fearless resolve to save the victim’s life. Trainers must strongly emphasise this necessary trade-off during CPR training to better impress upon students the importance of bystander CPR in case of OHCA. If trainees can remember to call the emergency number, the dispatchers are trained to calm and reassure the caller, even as they guide them through the steps of CPR and AED use.
Remembering to dial 9-9-5 is critical. We were encouraged to see that ‘having a person of authority guide them’ was the second most frequently selected response in the post-training survey (Question 10), which asked students to identify what aspect of the training they liked most. This result could be because our students understood that they could call the emergency number and a trained dispatcher would guide them through CPR/AED use, thus allaying their anxiety somewhat about forgetting what to do. It could also be that they liked the idea that someone would be there to act as virtual witness to their resuscitation attempts and thus felt safe from criticism about what they were about to do. We believe, whatever be the reasons for such favourable ranking, that some observations should be made here: (a) students understood that they needed to call the emergency number (9-9-5); (b) with dispatcher support, they were not left alone to conduct CPR; and (c) they felt a sense of relief from not having to fear doing something wrong because someone of authority was there to guide them through.

It is critical that CPR/AED trainings help trainees to understand that feeling anxious is a normal part of resuscitation but in the face of that, they must adopt a lifesaver mentality. We believe this can be enhanced through enriching a student’s perspective about what is at stake in a resuscitation attempt. One idea we found particularly constructive was reported by a Belgian study conducted by Stroobants et al. They demonstrated successful attitude changes resulting from having schoolchildren teach basic life support to their network of family and friends. This could be particularly successful in Singapore if it were part of a school assignment. By having children teach their newly acquired knowledge and skill, they would acquire a deeper understanding of the CPR training and develop a stronger commitment to doing it while appreciating afresh that such efforts could perhaps even save the life of a loved one. At the same time, this sharing increases the dispersion of CPR knowledge. This dispersion mechanism would thus be repeated over and over again with successive students entering into the school system.
This study was predicated on the belief that school students can play an important role in the effort to increase Singapore’s bystander CPR rate in the future. Scaling up the number of schools trained and even making it a mandatory part of course curriculum should be policy questions worth considering in Singapore. Whether the efforts we make now will bear fruit in the future must be left to future research. We presume that our study will form a significant part of the baseline against which researchers will measure progress.

Our study was not without limitations. No post-training follow-up was done to check retention of knowledge and skills among participating students. Knowledge and skill retention of learners are important considerations because the need to use CPR/AED may not arise for many years, if at all, after training. Studies have shown that there is a drop in skill retention when tested six months after initial training. We do not doubt nor underrate the importance of a drop-off in knowledge and skill post training. However, based particularly on the high number of correct recall of Singapore’s emergency number in both the pre-training (72.3% overall) and post-training (99.2% overall) surveys, most of our trainees should remember to call it in the event of an emergency. If so, the trained dispatcher would then guide them through the various CPR/AED steps, which, theoretically, would be able to offset any knowledge and/or skill drop-off that may have occurred over time.

Our survey questions could have had an unforeseen consequence of artificially shifting the results we observed for Question 7a on the likeliness of doing CPR to the extent that this was not truly reflective of how the students felt. This may have caused an underestimation of the positive impact our training had on students’ attitudes. Some caution in interpreting this result is therefore warranted.

In conclusion, following a video-based CPR/AED training with hands-on practice, a pilot group of Singapore schoolchildren demonstrated CPR/AED knowledge acquisition, mostly desirable shifts in how they felt about responding to OHCA and a good response to the
training medium after training. These were measured by pre- and post-training surveys on the training day itself. However, in some key areas, we observed certain concerns and misconceptions among schoolchildren pre-training, which lingered into post-training. These observations should inform public training targeted at Singapore’s youth.

REFERENCES


Table III. Percentage of correct answers for the knowledge-testing questions (Questions 1–5).

<table>
<thead>
<tr>
<th>Question</th>
<th>Students who answered all questions correctly (%)</th>
<th>Overall (n = 1,196)</th>
<th>School A (n = 261)</th>
<th>School B (n = 45)</th>
<th>School C (n = 325)</th>
<th>School D (n = 499)</th>
<th>School E (n = 66)</th>
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<tbody>
<tr>
<td></td>
<td>Pre-training</td>
<td>Post-training</td>
<td>Pre-training</td>
<td>Post-training</td>
<td>Pre-training</td>
<td>Post-training</td>
<td>Pre-training</td>
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<tr>
<td>Question 1: What is the first thing you should do if you see a person collapse? Correct answer: a) Check for danger and move him away, if necessary</td>
<td>36.6</td>
<td>93.8</td>
<td>14.2</td>
<td>85.4</td>
<td>15.6</td>
<td>55.6</td>
<td>48.0</td>
</tr>
<tr>
<td>Difference (95% CI)</td>
<td>57.2 (54.3–60.1)</td>
<td>71.2 (65.4–77.1)</td>
<td>40.0 (22.2–57.8)</td>
<td>50.2 (44.3–56.0)</td>
<td>56.9 (52.4–61.5)</td>
<td>50.0 (35.0–65.0)</td>
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<tr>
<td>p-value</td>
<td>&lt; 0.001</td>
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<tr>
<td>Question 2: What is the correct no. you should dial for an emergency ambulance?</td>
<td>72.3</td>
<td>99.2</td>
<td>65.5</td>
<td>98.9</td>
<td>100.0</td>
<td>95.6</td>
<td>71.1</td>
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<tr>
<td>Question 3: What should you do after you get through to the dispatcher on the emergency line?</td>
<td>Correct answer: c)</td>
<td>Difference (95% CI)</td>
<td>p-value</td>
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<td>56.4 (38.3 to 44.2)</td>
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<td>48.3 (41.7 to 54.8)</td>
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<td></td>
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<td>20.0 (−0.3 to 40.3)</td>
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<td>44.3 (38.5 to 50.1)</td>
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<td>38.1 (33.6 to 42.6)</td>
<td>&lt; 0.001</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>36.4 (23.2 to 49.5)</td>
<td>&lt; 0.001</td>
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</table>

<table>
<thead>
<tr>
<th>Question 4: How deep</th>
<th>Correct answer:</th>
<th>Difference (95% CI)</th>
<th>p-value</th>
</tr>
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<tr>
<td></td>
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<td>44.5 (38.3 to 44.2)</td>
<td>&lt; 0.001</td>
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<tr>
<td></td>
<td></td>
<td>33.7 (41.7 to 54.8)</td>
<td>&lt; 0.001</td>
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<tr>
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<td>40.0 (−0.3 to 40.3)</td>
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<td>58.2 (38.5 to 50.1)</td>
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<tr>
<td></td>
<td></td>
<td>38.1 (33.6 to 42.6)</td>
<td>&lt; 0.001</td>
</tr>
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<td></td>
<td></td>
<td>36.4 (23.2 to 49.5)</td>
<td>&lt; 0.001</td>
</tr>
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</table>
should chest compression be done for a collapsed person? Correct answer: b) 5 cm

<table>
<thead>
<tr>
<th>Difference (95% CI)</th>
<th>54.0 (51.1–56.9)</th>
<th>64.0 (57.8–70.2)</th>
<th>42.2 (24.3–60.1)</th>
<th>41.8 (36.2–47.5)</th>
<th>59.3 (54.8–63.9)</th>
<th>42.4 (29.0–55.9)</th>
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</thead>
<tbody>
<tr>
<td>p-value</td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
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</table>

Question 5: How fast should chest compression be done for a collapsed person? Correct answer: c) 100/min

<table>
<thead>
<tr>
<th>Difference (95% CI)</th>
<th>59.6 (56.6 to 62.7)</th>
<th>16.5 (9.9 to 23.0)</th>
<th>13.7 (–2.1 to 29.4)</th>
<th>71.0 (65.7 to 76.5)</th>
<th>80.4 (76.7 to 84.0)</th>
<th>48.5 (34.2 to 62.8)</th>
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</thead>
<tbody>
<tr>
<td>p-value</td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
<td>0.109</td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
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</table>

AED: automated external defibrillator; CI: confidence interval; CPR: cardiopulmonary resuscitation
**Figures**

![Bar chart](image)

**Fig. 1** Bar chart shows response to Question 6: How likely are you to perform CPR on a collapsed person today? CPR: cardiopulmonary resuscitation
Fig. 2 Bar chart shows response to Question 7a: What is the most important reason why you are less likely to do CPR on a collapsed person today?

CPR: cardiopulmonary resuscitation
**Fig. 3** Bar chart shows response to Question 7b: What is the most important reason why you are likely to do CPR on a collapsed person today?

CPR: cardiopulmonary resuscitation
Fig. 4 Bar chart shows response to Question 8: How likely are you to use an AED on a collapsed person today? AED: automated external defibrillator
**Fig. 5** Bar chart shows response to Question 9a: What is the most important reason why you are less likely to use an AED today? AED: automated external defibrillator
Fig. 6 Bar chart shows response to Question 9b: What is the most important reason why you are likely to use an AED today? AED: automated external defibrillator
**Fig. 7** Bar chart shows top five favourite pre- and post-training responses to Question 10 (What would you like to have in a class about CPR/AED?) for all schools. AED: automated external defibrillator; CPR: cardiopulmonary resuscitation
APPENDICES

Appendix A: pre-training survey
Class ______________________                          Participant Number ______________________

Dear Student, This is a simple 10-question survey about your knowledge, attitudes and beliefs about CPR (Cardio-Pulmonary Resuscitation) & AED (Automated External Defibrillator) today. Your response will help us understand how to teach you better. Your grades will not be affected by this so please answer truthfully and do not guess what the “correct” answer is.

1. What is the first thing you should do if you see a person collapse?
   a) Check for danger and move him away if necessary.
   b) Call for help.
   c) Start chest compressions.
   d) Use an AED.
   e) I don’t know.

2. What is the correct number you should dial for an emergency ambulance?
   a) 911
   b) 995
   c) 999
   d) 1777
   e) I don’t know.

3. What should you do after you get through to the dispatcher on the emergency line?
   a) Shout “help” and put the phone down quickly.
   b) Give my current location and put the phone down quickly.
   c) Stay on the line while the dispatcher teaches me how to do CPR until the ambulance arrives.
   d) Do not stay on the line as that will delay the ambulance.
   e) I don’t know.

4. How deep should chest compressions be done for a collapsed person?
   a) 1cm
   b) 5cm
   c) 10cm
d) No specific depth, as long as I am gentle

    e) I don’t know

5. How fast should chest compressions be done for a collapsed person?
   a) 30 per minute
   b) 60 per minute
   c) 100 per minute
   d) No specific rate, as long as it is slow
   e) I don’t know

6. How likely are you to perform CPR on a collapsed person today?
   a) Very unlikely
   b) Unlikely
   c) I don’t know
   d) Likely
   e) Very likely

   *If you answered a, b, c to Question 6, please proceed to Question 7a and do not answer 7b.*

   *If you answered d, e to Question 6, please proceed to Question 7b and do not answer 7a.*

7a. What is the most important reason why you are less likely to do CPR on a collapsed person today?
   a) I am scared I might accidentally hurt the victim.
   b) I feel my duty as a bystander is just to call the ambulance and wait for help to arrive.
   c) I have never been taught what to do.
   d) I do not want to be scolded if I do the wrong thing.
   e) Others (please specify): ________________________________

7b. What is the most important reason why you are likely to do CPR on a collapsed person today?
   a) I feel I am more likely to help a person who has already collapsed, than do him harm.
   b) I feel it is my duty to help someone in need.
   c) I have been taught how to do CPR before.
   d) I have been encouraged to help others in need.
   e) Others (please specify): ________________________________
8. How likely are you to use an AED on a collapsed person today?
   a) Very unlikely
   b) Unlikely
   c) I don’t know
   d) Likely
   e) Very likely

   *If you answered a, b, c to Question 8, please proceed to Question 9a and do not answer 9b.*

   *If you answered d, e to Question 8, please proceed to Question 9b and do not answer 9a.*

9a. What is the most important reason why you are less likely to use an AED today?
   a) I am scared I might accidentally hurt the victim.
   b) I feel my duty as a bystander is just to call the ambulance and wait for help to arrive.
   c) I have never been taught what to do.
   d) I do not want to be scolded if I do the wrong thing.
   e) Others (*please specify*): __________________________

9b. What is the most important reason why you are likely to use an AED today?
   a) I feel I am more likely to help a person who has already collapsed, than do him harm.
   b) I feel it is my duty to help someone in need.
   c) I have been taught how to use an AED before.
   d) I have been encouraged to help others in need.
   e) Others (*please specify*): __________________________

10. What would you like to have in a class about CPR/AED? *You may circle more than 1 answer.*
   a) A humorous video.
   b) A person of authority to guide me through the video.
   c) Real-life accounts of survivors and rescuers.
   d) Lecture notes or an instruction manual to bring home.
   e) Others (*please specify*): __________________________
Appendix B: post-training survey

Class ______________________  Participant Number ______________

Dear Student, This is a simple 10-question survey about your knowledge, attitudes and beliefs about CPR (Cardio-Pulmonary Resuscitation) & AED (Automated External Defibrillator) today. Your response will help us understand how to teach you better. Thank you for your participation!

1. What is the first thing you should do if you see a person collapse?
   a) Check for danger and move him away if necessary.
   b) Call for help.
   c) Start chest compressions.
   d) Use an AED.
   e) I don’t know.

2. What is the correct number you should dial for an emergency ambulance?
   a) 911
   b) 995
   c) 999
   d) 1777
   e) I don’t know.

3. What should you do after you get through to the dispatcher on the emergency line?
   a) Shout “help” and put the phone down quickly.
   b) Give my current location and put the phone down quickly.
   c) Stay on the line while the dispatcher teaches me how to do CPR until the ambulance arrives.
   d) Do not stay on the line as that will delay the ambulance.
   e) I don’t know.

4. How deep should chest compressions be done for a collapsed person?
   a) 1cm
   b) 5cm
   c) 10cm
   d) No specific depth, as long as I am gentle
   e) I don’t know.
5. How fast should chest compressions be done for a collapsed person?
   a) 30 per minute
   b) 60 per minute
   c) 100 per minute
   d) No specific rate, as long as it is slow
   e) I don’t know

6. How likely are you to perform CPR on a collapsed person today?
   a) Very unlikely
   b) Unlikely
   c) I don’t know
   d) Likely
   e) Very likely

If you answered a, b, c to Question 6, please proceed to Question 7a and do not answer 7b.
If you answered d, e to Question 6, please proceed to Question 7b and do not answer 7a.

7a. What is the most important reason why you are less likely to do CPR on a collapsed person today?
   a) I am scared I might accidentally hurt the victim.
   b) I feel my duty as a bystander is just to call the ambulance and wait for help to arrive.
   c) I have never been taught what to do.
   d) I do not want to be scolded if I do the wrong thing.
   e) Others (please specify): ________________________________

7b. What is the most important reason why you are likely to do CPR on a collapsed person today?
   a) I feel I am more likely to help a person who has already collapsed, than do him harm.
   b) I feel it is my duty to help someone in need.
   c) I have been taught how to do CPR before.
   d) I have been encouraged to help others in need.
   e) Others (please specify): ________________________________

8. How likely are you to use an AED on a collapsed person today?
a) Very unlikely
b) Unlikely
c) I don’t know
d) Likely
e) Very likely

*If you answered a, b, c to Question 8, please proceed to Question 9a and do not answer 9b.*
*If you answered d, e to Question 8, please proceed to Question 9b and do not answer 9a.*

**9a. What is the most important reason why you are less likely to use an AED today?**

a) I am scared I might accidentally hurt the victim.
b) I feel my duty as a bystander is just to call the ambulance and wait for help to arrive.
c) I have never been taught what to do.
d) I do not want to be scolded if I do the wrong thing.
e) Others *please specify*: ________________________________

**9b. What is the most important reason why you are likely to use an AED today?**

a) I feel I am more likely to help a person who has already collapsed, than do him harm.
b) I feel it is my duty to help someone in need.
c) I have been taught how to use an AED before.
d) I have been encouraged to help others in need.
e) Others *please specify*: ________________________________

**10. What aspects of this class on CPR/AED did you enjoy? You may circle more than 1 answer.**

a) A humorous video.
b) A person of authority to guide me through the video.
c) Real-life accounts of survivors and rescuers.
d) Lecture notes or an instruction manual to bring home.
e) Others *please specify*: ________________________________

**11. If you have any further comments or questions, please feel free to write them. We will address them and send our replies back to you through your school. ________________**