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Simulation and education

Comparison of instructor-led compression-only cardiopulmonary resuscitation and automated external defibrillator training for secondary school students: A multicenter noninferiority randomized trial

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Abstract

Background: Many barriers exist to the wider and sustainable implementation of basic life support (BLS) training in secondary schools. Whether trained teacher instructors are not worse than healthcare instructors by 20% (noninferiority margin) of simulated BLS skills for secondary school students is unclear.

Methods: We conducted a two-armed, parallel, noninferiority, blinded, randomized controlled trial at four secondary schools in Hong Kong after teachers had undergone BLS training. Students were randomized to either the trained teacher or healthcare instructor group for the 2-hour compression-only cardiopulmonary resuscitation and automated external defibrillator (CO-CPRAED) course. The assessors for the students' BLS skill performance six months after the CO-CPRAED course were blinded.

Results: Of the 33 trained teachers, 13 (39.4%) volunteered to be instructors for the CO-CPRAED course. Three hundred and eleven students (median age: 15 years, 67% males) were randomized to either the teacher ($n = 161$) or healthcare ($n = 150$) instructor group. The BLS skill performance passing rate (%) at six months was high in both instructor groups (teacher: 88% versus healthcare: 91%; mean difference: −3%, 95% CI: −11% to 5%; $P = 0.22$). The students' knowledge levels remained high (>90%) and were similar between instructor groups at six months ($P = 0.91$). The teachers' willingness to teach BLS to students was mildly positive. However, the students were extremely positive towards learning and performing BLS.

Conclusions: A brief 2-hour CO-CPRAED intervention by trained teachers was noninferior to healthcare instructors and it was associated with students' very positive attitudes towards CPR, and retention of knowledge and BLS skills.

Keywords: Adolescent, Education, Out-of-hospital cardiac arrest, Hong Kong

Introduction

Out-of-hospital cardiac arrest (OHCA) is one of the leading causes of global mortality.[1] The Hong Kong hospital discharge or 30-day survival rate is 2.3%,[2] a dismal rate compared with the global estimate of 9.9–13.3%.[3] The possible contributing factors to the modest Hong Kong survival rate include the low rates of bystander cardiopulmonary resuscitation (CPR) (<30%) and automated external defibrillator (AED) use (<2%).[2,4] In contrast, the 2019 rates of Danish bystander CPR and 30-day survival were 80% and 14%, respectively.[5]

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As students can easily be motivated, learn quickly and retain skills longer, implementing basic life support (BLS) training in schools has the potential to educate whole generations to respond to cardiac arrests and to increase survival after OHCA.[6] Our previous study showed that it was feasible to train 13- to 15-year-old students BLS at school using a brief 2-hour compression-only CPR and AED (CO-CPRAED) course led by healthcare professional instructors.[7] However, the logistics of bringing volunteer healthcare instructors into schools for BLS training requires considerable effort and is unsustainable in the long term. Other major barriers to the wider implementation of BLS training in secondary schools include the lack of funding for teaching resources, manikins and associated equipment, curriculum pressure, poor senior leadership support and lack of teacher training.[8–10]

School leadership and teachers consider an up-to-date BLS course to be a prerequisite to training students for the long-term sustainability of BLS training.[9–11] A survey about the readiness of Hong Kong secondary school teachers to teach CPR showed that local teachers' willingness to teach CPR was poor (32%).[8] The reasons included poor BLS knowledge, lack of confidence in performing and teaching BLS, and genuine concerns about legal liability (Good Samaritan law is not currently available in Hong Kong).[8,12] In contrast, previous European observational studies[13,14] have shown positive associations between teacher-led BLS training and students' learning. Given these findings, we performed a multicenter noninferiority randomized trial to assess whether the effect of trained teacher instructors is not worse than healthcare instructors-led CO-CPRAED training by 20% (noninferiority margin) of simulated BLS skills for secondary school students.

Methods

Trial design and participants

We conducted a two-armed, parallel, noninferiority, blinded, randomized controlled trial (RCT) at four secondary schools in Hong Kong. The Chinese University of Hong Kong (CUHK) Survey and Behavioural Research Ethics Committee (SBRE(R)-21-020) approved the study protocol. Written informed consent was obtained from the school principals, teachers and parents of participating students. The trial was registered at the Chinese Clinical Trial Registry (ChiCTR1900027130). The manuscript adheres to the applicable CONSORT guidelines.

We recruited secondary school teachers at five participating schools from July 2019 to October 2022 for the American Heart Association (AHA) BLS training. The AHA BLS provider courses were conducted at the teachers' school for free before the student CO-CPRAED training. Students aged 14–18 years, with or without prior BLS or AED training, were recruited to participate in the study after the school's confirmation of extra time available for BLS training and 6-month follow-up in the school curriculum. There were no other exclusion criteria.

Randomization and blinding

For each school, students were randomly assigned, in a 1:1 allocation ratio using computer-generated randomization codes, to either the trained teacher instructor or the healthcare instructor group for CO-CPRAED training. The random allocation sequence generation was performed by an author (AL) not involved in the study recruitment, teaching CO-CPRAED or data collection. Students were given an envelope (prepared by HHTC not involved in student recruitment, teaching or outcome assessment) containing their treatment allocation and a numbered label to place on their shirt on the day of instruction. The outcome assessors, different AHA-accredited BLS instructors who were not involved in teaching CO-CPRAED, were blinded to the students' treatment allocation at 6-month follow-up. The students completing both training and follow-up assessments were given a CUHK CPR for Schools Participation Certificate to reduce the attrition bias.

Instructor groups for CO-CPRAED training

The trained teacher instructor group included teachers with a current AHA BLS provider certificate willing to teach the CO-CPRAED course. We provided teachers with a teaching video and training materials from the CPR in School Training Kit™ a week before the students' training day to help with lesson preparation. All the volunteer healthcare instructors in the control group were AHA BLS practitioners from Emergency Medicine, Intensive Care or Anesthesiology specialties.

On the day, the study authors provided a one-hour briefing session to both instructor groups. The session included reviewing the CO-CPRAED course materials and lesson plan, repeat demonstration (and practice) on the manikins to highlight the important points of performing BLS with students, and discussions on how to answer the potential questions raised by students during the CO-CPRAED course.

Students BLS intervention

We previously described the content, lesson plan and equipment needed for the 2-hour CO-CPRAED course.[7] Our course was based on the AHA 'CPR in School Training Kit™' program. Briefly, this involved a discussion with students on how to identify a cardiac arrest victim and what initial steps to take when encountering a cardiac arrest victim (10 min), showing the teaching video demonstrating compression only-CPR (CO-CPR) and the safe use of an AED (10 min), and students practising hands-only CPR and AED skills on manikins (75 min) using a skill practice while watching strategy. Instructors in both groups gave specific feedback to individual students on the correct hand positioning, and appropriate rate and depth of compression while practising CO-CPR on a Laerdal Mini Anne manikin for 15 minutes. Instructors then demonstrated the correct positioning of AED pads, how to deliver the first shock safely and emphasized the need for CO-CPR continuation after the first defibrillation on a Laerdal Little Anne manikin in small groups.

Individual students in both groups practised the steps involved in a simulated cardiac arrest scenario, with individual feedback and prompts from their small group instructor. Up to 40 students/session were trained in both groups, with a student-to-instructor ratio that did not exceed 10:1. To practise the hands-on compressions, the manikin-to-student ratio was 1:1 in both groups. For a simulated cardiac arrest, the manikin and AED-to-student ratio was 1:10 in both groups. These ratios followed the AHA 'CPR in School Training Kit™ program recommendations.

Outcomes and measures

The primary outcome was the passing rate of students' BLS performance skills at 6-month follow-up, applying a noninferiority margin of 20%. The secondary outcomes were changes in the knowledge and attitudes of students and trained teachers, and uptake of teacher instructors for the CO-CPRAED courses (%).

School teachers study instruments

The recruited teachers were given a questionnaire before the BLS provider course training. The questionnaire included five 4-stem multiple choice questions based on the AHA 2015 BLS guidelines, one question on the need for mandatory CPR training in secondary schools and five attitude statements towards teaching CPR in schools with Likert scale responses.[8] We assessed the teachers' knowledge and attitudes towards teaching CPR using the same questionnaire after the BLS provider course,

Student study instruments

(a) Objective structured clinical examination (OSCE)

The students were assessed on their ability to act in a cardiac arrest scenario, perform CO-CPR and use an AED on a manikin (LittleAnne; Laerdal) safely using a simulated cardiac arrest scenario. Each student was tested individually in another room and was blinded to the performance of other students. The test ended when CO-CPR was continued for one minute after the first defibrillation. The marking standard was adapted from the AHA Heartsaver Course. The OSCE passing rate was calculated as the proportion of students meeting all nine checklist items.[7]

(b) Knowledge and attitudes questionnaire

The students in both groups completed a knowledge and attitudes questionnaire before, immediately after training and at 6-month follow-up. The questions were adapted from CPR in School Training Kit™ and from a previously validated local questionnaire on attitudes towards CPR.[15] The questionnaire included 5-item multiple choice questions about the knowledge of compression-only CPR and AED, 10 statements with Likert scale responses about their attitudes towards bystander CPR and AED, five statements with Likert scale responses (1 = very unimportant to 5 = very important) about factors affecting students' decision not to perform CPR and three questions on enabling factors to perform CPR. We considered a 20% increase in knowledge score to be clinically meaningful.[7] The total score for the attitude was out of 30, with a higher score reflecting a more positive attitude.

Sample size

Sample sizes of 152 students in the trained teacher instructor group and 152 in the healthcare instructor group will achieve 90% power to detect a noninferiority margin of 20% based on a previous study with 4-month follow-up.[16] The test statistic used was a one-sided Z test (pooled) and at a significance level of the test was 0.025 (equivalent to a 95% two-sided confidence interval). Taking the lost to follow-up rate of 10% into account, the total sample size was adjusted to 335. The sample size calculations were performed using PASS 14 Power Analysis and Sample Size Software (NCSS, LLC. Kaysville, Utah, USA).

Data analysis

As there were no crossovers in the treatment allocation, the modified intention-to-treat analysis[17] and per-protocol analysis for the primary outcome was the same using the available outcome data. No imputation was carried out for the occasional missing responses to knowledge questions or attitude statements. We visually compared the Likert scale responses to the attitudes towards CPR statements and barriers to performing CPR statements over time by drawing diverging stacked bar charts.[18] The changes in teachers' and students' level of knowledge and attitude towards teaching and learning CPR were analyzed using McNemar's tests and generalized estimating equations (GEE)[19] adjusting for a school effect as appropriate. The GEE method is more flexible than a repeated measures analysis of variance for handling different types of outcomes, correlations and missing data.[19] A sensitivity analysis on the baseline characteristic of the student population by instructor group with complete 6-month follow-up data was performed to assess if attrition bias would bias the treatment effect.[20]

The between instructor group difference in the overall students' BLS skills performance skill passing rate was estimated using a modified Poisson regression after taking a school effect into account.[21] Noninferiority was declared if the lower bound of 1-sided 97.5% (corresponding to a 2-sided 95% CI) was within the noninferiority zone.[22] Stata version 18.0 (StataCorp, College Station, TX) and SPSS version 27.0 (IBM, Armonk, NY) were used for data analysis. Alpha level for two-sided tests was set at $P < 0.05$.

Results

Of the 33 trained teachers from five schools (four single-sex schools and one private coeducational international school), 16 did not have the opportunity to teach CO-CPRAED due to school closures (social unrest in 2019/2020 and COVID-19 pandemic). Twenty-six (78.8%) teachers were under 45 years and 19 (57.6%) were male. Two (6.1%) teachers had witnessed a cardiac arrest. Most teachers (78.8%) had received CPR training, but most (60.6%) had no AED training before the AHA BLS training. The main incentives for teachers' attendance at BLS training were if classes were offered at the school (100%), free (87.1%) and after the exam period (76.7%). Although 23 (69.7%) teachers were willing to teach the CO-CPRAED course, 13 (39.4%) volunteered to be instructors. The mean (SD) interval between AHA BLS training and CO-CPRAED instruction was 80 (62) days.

Of the 329 students from four secondary schools eligible for participation, 311 (94.5%) were randomized to either the teacher ($n = 161$) or healthcare ($n = 150$) instructor group between November 2021 to December 2022 (Fig. 1). The baseline characteristics between instructor groups were similar (Table 1) and the result was robust in the sensitivity analysis (Supplementary Table 1). The mean (SD) interval between CO-CPRAED training and follow-up was 174 (48) days.

Teachers' knowledge and attitudes

Two (6.1%) teachers did not complete the knowledge section of the questionnaire. The pre-post knowledge responses from trained teachers are shown in Table 2. The overall knowledge scores improved from 57% (95% CI: 48–65%) to 95% (95% CI: 91–99%) (mean difference 38%, 95% CI: 29–47%) (Table 2).

Fifteen of the 32 teachers (45.5%) believed that CPR training should be mandatory for students. The responses to the five statements about attitude and willingness to teach CPR before and after AHA BLS training are shown in Fig. 2. Half the teachers (51.6%) were concerned about the legal liability related to CPR training for their students (Fig. 2). There was a significant change in the mean attitude and willingness to teach CPR scores (out of 25) over time (pre-training 13.9, 95% CI: 12.9–14.9; post-training 16.3, 95% CI: 15.5–17.2; mean difference: 2.4, 95% CI: 1.4–3.3) after adjusting for a school effect ($P = 0.002$).

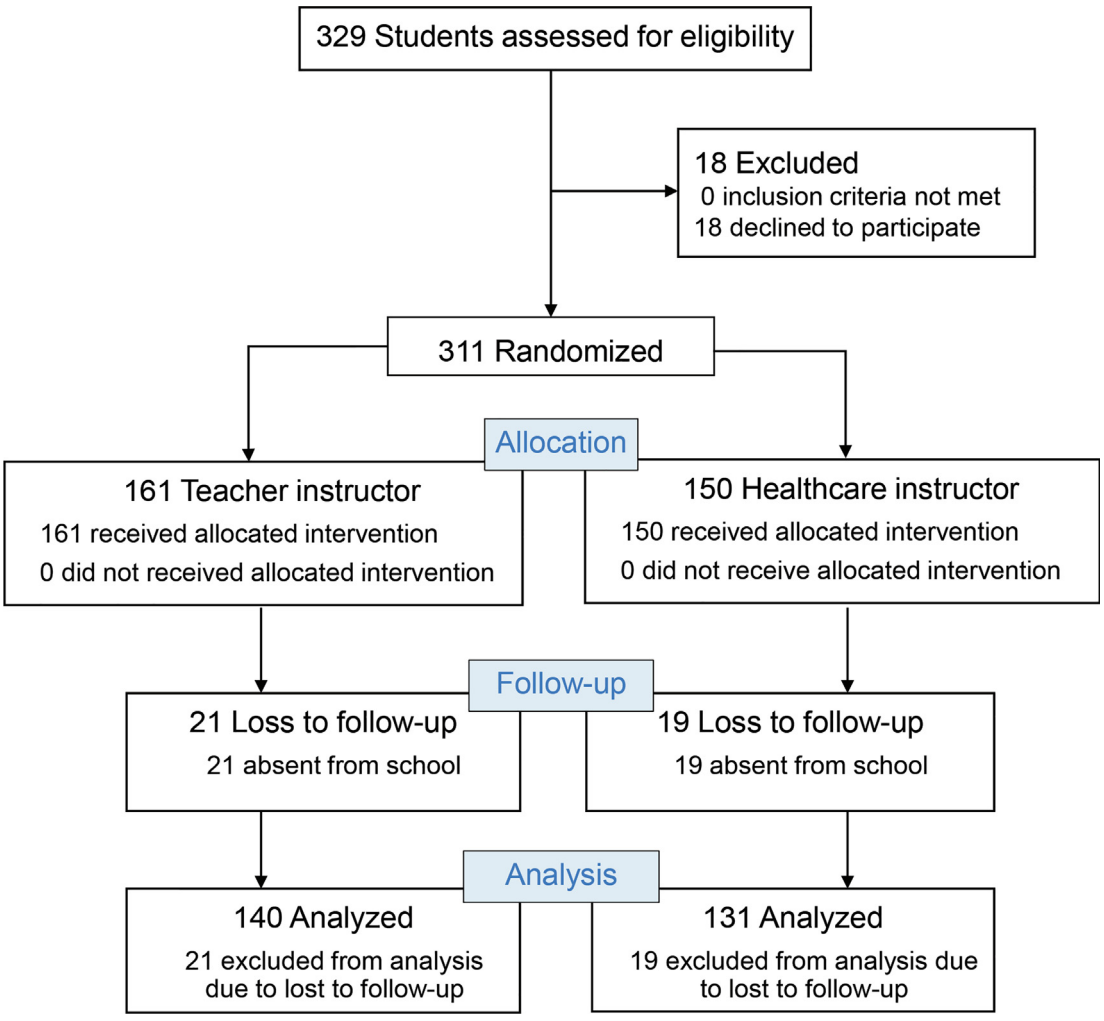

Fig. 1 – Study flowchart from recruitment to 6-month follow-up.

Table 1 – Baseline characteristics of intention-to-treat student population.

Characteristic	Students, No. (%)	
	Teacher instructor group (n = 161)	Healthcare instructor group (n = 150)
School		
1	35 (21.7)	35 (23.3)
2	27 (16.8)	25 (16.7)
3	65 (40.4)	61 (40.7)
4	34 (21.1)	29 (19.3)
Sex		
Males	108 (67.1)	101 (67.3)
Females	53 (32.9)	49 (32.7)
Median (IQR) age, years	15 (15–16)	15 (15–16)
Median (IQR) weight, kg	56.0 (50.0–63.5)	56.0 (50.0–64.0)
Prior CPR/AED training	4 (2.5)	10 (6.7)

Abbreviations: AED, automated external defibrillator; CPR, cardiopulmonary resuscitation; IQR, interquartile range.

Students' OSCE skill performance

The OSCE passing rate varied between schools at 6-month follow-up, ranging from 83% to 98% (P = 0.002). The overall unadjusted passing rate was similar between instructor groups; the trained teacher group (88%) was no worse than healthcare professionals (91%) (mean difference −3.1%, 95% CI −10.4% to 4.3%, Table 3). After adjusting for the school effect, the mean difference between groups was −3.2% (95% CI: −11.3% to 4.9%), indicating noninferiority

Table 2 – Teachers' and students' correct responses (%) to knowledge questions over time.

Questions	Group	Baseline	After	6-month follow-up	*P* value
		Teachers, No. (%)			
What is the order of steps that you will take to save this person?[a]	BLS Provider	26/31 (83.9)	31/31 (100)	–	0.025
What happens to the chances of survival if the victim is left untreated?[a]	BLS Provider	24/31 (77.4)	27/31 (87.1)	–	0.257
Which of the following is the desirable rate of chest compression?[a]	BLS Provider	15/31 (48.4)	31/31 (100)	–	<0.001
Which of the following is the desirable depth of chest compression?[a]	BLS Provider	12/30 (40.0)	29/30 (96.7)	–	<0.001
Which of the following is the recommended compression to breathing ratio?[a]	BLS Provider	10/31 (32.3)	29/31 (93.5)	–	<0.001
Mean (95% CI) overall knowledge score (%)[b]	BLS Provider	57 (48–65)	95 (91–99)	–	<0.001
Questions	Instructor Group	Students, No (%)			
When performing hands-only CPR, how many times should you push in the centre of the chest during a 1 min period?	Teacher	78/161 (48.4)	159/161 (98.8)	124/140 (88.6)	0.817[c]
	Healthcare	79/150 (52.7)	150/150 (100)	118/131 (90.1)	
When do you stop pushing on the victim's chest during hands-only CPR?	Teacher	106/161 (65.8)	157/161 (97.5)	131/140 (93.6)	0.233[c]
	Healthcare	102/150 (68.0)	147/150 (98.0)	129/131 (98.5)	
How deep should you push on the chest of an adult when doing hands-only CPR?	Teacher	97/161 (60.2)	152/161 (94.4)	121/140 (86.4)	0.650[c]
	Healthcare	90/150 (60.0)	146/150 (97.3)	111/131 (84.7)	
What does an automated external defibrillator (AED) do?	Teacher	125/161 (77.6)	157/161 (97.5)	133/140 (95.0)	0.961[c]
	Healthcare	115/150 (78.7)	147/150 (98.0)	125/131 (95.4)	
What are the correct steps for providing hands-only CPR?	Teacher	119/161 (73.9)	157/161 (97.5)	134/140 (95.7)	0.454[c]
	Healthcare	102/150 (68.0)	147/150 (98.0)	127/131 (96.9)	
Mean (95% CI) overall knowledge score (%)[c]	Teacher	65 (61–69)	97 (96–98)	92 (90–94)	0.909
	Healthcare	65 (61–69)	98 (97–99)	93 (91–95)	

[a] McNemar's test in school teacher participants with complete before and after training data.
[b] Generalized estimating equation in teacher participants adjusted for school effect.
[c] Generalized estimating equation in student participants adjusted for school effect, group * time interaction *P* value.

(*P* = 0.221) was met. We found similar results when students with prior CPR or AED training were excluded from the analysis (Supplementary Table 2).

Students' knowledge and attitudes

Student responses to knowledge questions over time are shown in Table 2. The change from baseline to 6-month follow-up of student knowledge in the teacher (65–92%) and healthcare instructors' (65–93%) groups was 27% (95% CI: 22–31%) and 28% (95% CI: 23–33%) respectively (Table 2). The between-group change in knowledge score was similar (*P* = 0.431).

The responses to the 10 students' attitude statements towards CPR over time are shown in Supplementary Fig. 1. There was no change in mean attitude scores over time between the teachers' and healthcare instructors' group (*P* = 0.399) after adjusting for school differences (*P* = 0.040). The mean attitude scores were similar (*P* = 0.093) between the teacher instructor group (28.1, 95% CI: 27.8–28.3) and the healthcare instructor group (28.4, 95% CI: 28.1–28.6). Under half of the students (45.1%) would not perform CPR as they were worried about the legal responsibility and over half (57.6%) were worried about harming the victim if the CPR was performed incorrectly (Fig. 3). The important factors for performing CPR at follow-up were knowing that early CPR was associated with a higher survival rate (82.2%), life is precious even without CPR training (75.6%) and receiving CPR training at school (75.2%). At follow-up, 41 (29.7%) students in the teacher instructor group and 26 (19.8%) in the healthcare instructor group reported that the victim's identity would affect the decision to perform CPR (*P* = 0.062). One hundred and six (76.8%) students in the teacher instructor group and 87 (66.4%) in the healthcare instructor group would perform CPR on family members (*P* = 0.058). There was no difference between instructor groups for the willingness to perform CPR on any person in need (teacher 79.6% versus healthcare 84.0%; *P* = 0.351).

Discussion

Based on the students' BLS skills performance around six months after a brief CO-CPRAED course, this multi-school noninferiority

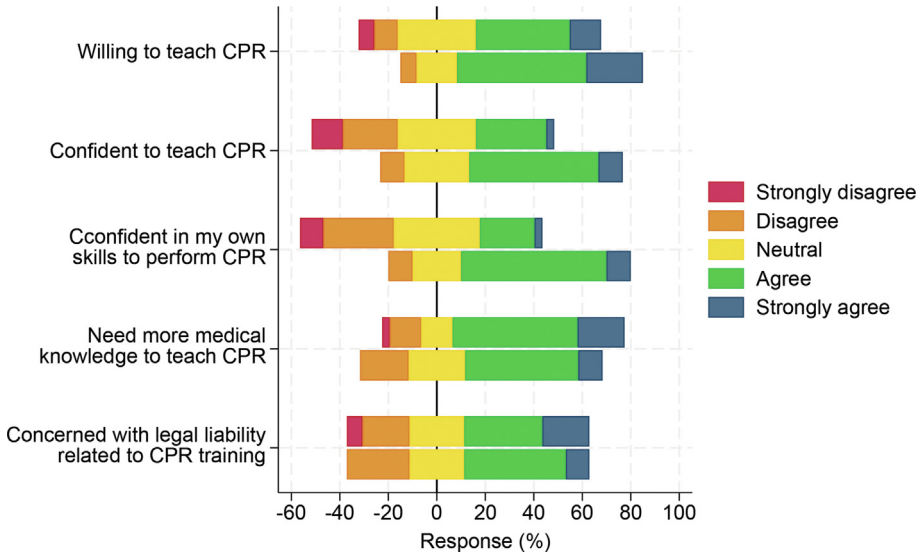

Fig. 2 – Diverging stacked bar chart for Likert responses to teachers' attitudes and willingness of teaching CPR statements before (first row) and immediately after (second row) training.

Table 3 – Skill performance in OSCE at 6-month follow-up after training.

Skills		Teacher (n = 140)	Healthcare (n = 131)	Mean difference (%, 95% CI)	P value
1.	Check response (n, %)	138 (98.6)	128 (97.7)	0.9 (−2.4 to 4.1)	0.598
2.	Shouts for help, sends someone to phone 999 and get an AED (n, %)	140 (100)	130 (99.2)	0.8 (−0.7 to 2.3)	0.300
3.	Performs high quality (correct rate and depth) compressions (n, %)	129 (92.8)[a]	122 (93.1)	−0.3 (−6.4 to 5.8)	0.917
4.	Powers on AED (n, %)	140 (100)	131 (100)	0.0 (0–0)	NA
5.	Correctly attaches pads (n, %)	138 (98.6)	130 (99.2)	−0.7 (−3.1 to 1.8)	0.601
6.	Clears for analysis (n, %)	137 (97.9)	130 (99.2)	−1.4 (−4.2 to 1.4)	0.347
7.	Clears to safely deliver a shock (n, %)	133 (95.0)	128 (97.7)	−2.7 (−7.1 to 1.7)	0.237
8.	Presses button to deliver shock (n, %)	139 (99.3)	130 (99.2)	0.0 (−2.0 to 2.1)	0.962
9.	Immediately resumes compressions (n, %)	139 (99.3)	130 (99.2)	0.0 (−2.0 to 2.1)	0.962
10.	Median (IQR) time to first shock (seconds)	60 (54–69)	60 (53–67)	0 (−3.0 to 3.0)[b]	1.000[b]
Unadjusted overall pass (n, %)		122 (87.8)[a]	119 (90.8)	−3.1 (−10.4 to 4.3)	0.208[c]
Adjusted effect overall pass (%, 95% CI)		87.9 (82.5–93.2)[a]	90.7(85.8–95.6)	−3.2 (−11.3 to 4.9)[d]	0.221[c]

Abbreviations: AED, automated external defibrillator; IQR, interquartile range; NA, not applicable; OSCE, objective structured clinical examination.

[a] One missing value.

[b] Quantile regression.

[c] Difference in proportion at one sided P value for noninferiority.

[d] Modified Poisson regression adjusting for school effect at one sided P value for noninferiority.

RCT showed that trained teacher instructors were noninferior to healthcare instructors. For every 10 teachers trained with the AHA BLS provider course, four became instructors for the CO-CPRAED course. Both the BLS training for teachers and CO-CPRAED training for students were associated with clinically meaningful improvements in CPR knowledge levels. There was no difference between instructor groups for students' knowledge levels at six months. The trained teachers had mildly positive attitudes and willingness to teach CPR to their students despite advocating for free BLS provider courses at the workplace. In contrast, students in both instructor groups had extremely positive attitudes towards learning and performing BLS that did not change over time except for satisfaction levels for knowledge to perform CPR.

To our knowledge, this is the first RCT comparing different categories of instructors with a teaching video for a brief school-based BLS training. The results were consistent with our previous pre-post study for CO-CPRAED skills performance, knowledge and attitudes.[7] Our findings support the results from two longitudinal studies comparing trained teachers to healthcare instructors,[13,14] with no instructor group differences found in CPR compression rate and depth.[14] A recent systematic review of 17 RCTs (n = 5578) showed that instructor-guided technology-based CPR training with hands-on practise and the real-time feedback was noninferior to the standard instructor-led demonstration and hands-on practise training in CPR skills and knowledge among adolescents.[23] Overall, the studies demonstrate the role of trained teacher instructors as an effective and sustainable model for BLS training.

Although a positive attitude toward CPR is likely to be a good predictor of a person willingness to perform CPR in a real situation,[15] almost half of the students were worried about the legal responsibility

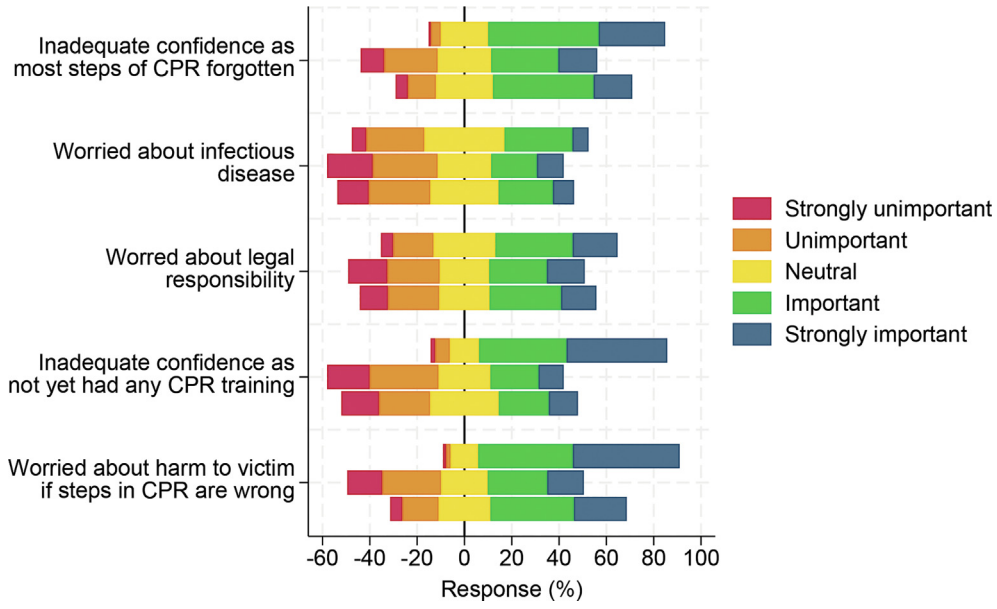

Fig. 3 – Diverging stacked bar chart for Likert responses to students' decision not to perform CPR statements before (first row), immediately after (second row) training and at follow-up (third row).

in this RCT. This is consistent with the results from our previous observational study.[7] Furthermore, half the trained teachers were concerned about the legal liability related to CPR training as the Good Samaritan Law is not currently in place in Hong Kong. A local survey suggests that if the Good Samaritan Law was enacted, 57% of first aid course participants would be more willing to perform bystander CPR.[24] Enacting the Good Samaritan Law may improve the teachers' willingness to be BLS instructors and increase the OHCA survival rates from the current low rates of bystander OHCA and use of AED.[2]

Limitations

Multiple school closures led to the slow recruitment of schools and students for this RCT. The trained teachers at one school did not recruit students as there was no curriculum time available to run the CO-CPRAED course. Although the teachers delivered the CO-CPRAED training successfully, they were not trained to assess the students' BLS skills. To address this limitation, we will assess the inter-rater reliability (agreement) between trained teacher instructors and healthcare BLS assessors in a future study. To facilitate a wider uptake of the CO-CPRAED course in local secondary schools, we have produced an instructional video in Cantonese (a Chinese dialect) since Cantonese is the main language of instruction. During this RCT, instructors used students' preferred language of instruction (English or Cantonese) in small group manikin practice sessions. A recent study in multiethnic communities highlighted the importance of training being conducted in the language of preference as an enabling factor for the uptake of BLS courses.[25]

Conclusions

Trained teachers were found to be noninferior to healthcare instructors in delivering CO-CPRAED training. The intervention was associated with students' very positive attitudes towards CPR, and retention of knowledge and BLS skills up to six months. Our findings demonstrate the effectiveness of trained teachers as instructors for CO-CPRAED training within the local school curriculum.

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Statement of contribution

This is to certify that all six authors (CYY, KYS, HHTC, PYH, HFK, AL) have made substantial contributions to the manuscript. CYY, HFK and AL conceived and designed the study. CYY, KYS, HHTC, HFK and AL conducted the trial and collected the data. CYY, PYH and AL contributed to the analysis, interpretation of data and drafting of the manuscript. All authors reviewed the manuscript and gave final approval for the submitted version. All authors are accountable for all the aspects of the work.

CRediT authorship contribution statement

Chi Yeung Yeung: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation, Writing – review & editing, Supervision. **Kit Ying So:** Investigation, Data curation, Writing – review & editing. **Helen Hoi Ting Cheung:** Investigation, Resources, Writing – review & editing, Project administration. **Pik Yi Hou:** Formal analysis, Data curation, Validation, Visualization, Writing – review & editing. **Hiu Fai Ko:** Conceptualization, Methodology,

Investigation, Writing – review & editing. **Anna Lee:** Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation, Validation, Visualization, Writing – original draft, Supervision, Project administration, Funding acquisition.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: 'CYY is a lecturer at the Hong Kong Red Cross. All other authors declare no conflicts of interest'.

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Appendix A

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Appendix B. Supplementary material

Supplementary material to this article can be found online at https://doi.org/10.1016/j.resplu.2023.100487.

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