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Original paper

The school Lifesavers study—A randomised controlled trial comparing the impact of Lifesaver only, face-to-face training only, and Lifesaver with face-to-face training on CPR knowledge, skills and attitudes in UK school children☆

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ABSTRACT

Background: Lifesaver (www.life-saver.org.uk) is an immersive, interactive game that can be used for basic life support training. Users 'resuscitate' a victim of cardiac arrest in a filmed scenario and move their device up and down to simulate cardiac compressions.
Methods: Randomised controlled trial of 3 UK schools (81 students) comparing Lifesaver, face-to-face (F2F) training, and a combination of both. Primary outcomes: mean chest compression rate and depth. Secondary outcomes: flow fraction, CPR performance, and attitude survey. Outcomes measured immediately, 3 and 6 months.
Results: Primary outcomes: Mean chest compression depth was suboptimal in all groups due to body size. F2F performed better than Lifesaver initially (−11.676; 95% CI −18.34 to −5.01; p = 0.0001) but no difference at 3 months (p = 0.493) and 6 months (p = 0.809). No difference in mean compression rates for Lifesaver vs F2F (−11.89; 95% CI −30.39 to −6.61; p = 0.280) and combined vs Lifesaver (0.25; 95% CI −17.4 to −17.9; p = 0.999). Secondary outcomes: all groups had flow fraction >60% after training. Combined group performed better for skills assessment than Lifesaver (4.02; 95% CI 2.81–5.22; p = 0.001) and F2F (1.76; 95 CI 0.51–3; p = 0.003); and the same at 6 months (1.92; 95% CI 0.19–3.64; p = 0.026 and 1.96; 95% CI 0.17–3.75; p = 0.029).
Conclusions: Use of Lifesaver by school children, compared to F2F training alone, can lead to comparable learning outcomes for several key elements of successful CPR. Its use can be considered where resources or time do not permit formal F2F training sessions. The true benefits of Lifesaver can be realised if paired with F2F training.

Introduction

The United Kingdom has one of the highest rates of cardiovascular disease in the world and approximately 60,000 out-of-hospital cardiac arrests (OHCA) occur every year, half of which are attended to by the emergency services [1,2,3]. Basic Life Support (BLS) can improve outcomes if it is swiftly performed at the scene of the cardiac arrest.

One of the main elements of BLS is cardiopulmonary resuscitation (CPR). Bystander CPR is important because it slows down the rapid decline in a patient's chances of survival while waiting for professional help. Currently the average bystander CPR rates in the UK range between 39 and 57% with survival to hospital discharge rates of 7.9% [3].

CPR training in school children

While educating the lay public in BLS is key to increasing survival from cardiac arrests, it is difficult to reach the entire population.

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One potential strategy is to educate school children as young as 12 years old. The American Heart Association advocated compulsory resuscitation training in American schools in 2011 [4]. Countries in which resuscitation has been integrated into school educational programs report significantly higher resuscitation rates [5–7]. Successful training of school children in Denmark has led to double the rate of bystander CPR after five years, and a threefold improvement in survival following OHCA over ten years [5,7].

In March 2013, the Department of Health in England published a Cardiovascular Disease Outcomes Strategy [8]. The Community Resuscitation Group was convened to develop a national approach to achieve the objectives of the strategy [9], leading to the publication in 2017 of the 'Resuscitation to Recovery' framework [10]. It recommended "greater awareness amongst the general public, including young people of school age, on how to recognise and manage cardiac arrest through the use of CPR and defibrillators".

In their systematic review, Plant and Taylor found that training school children in CPR from the age of 10 years old is effective [11–13]. It has been shown that early training helps reduce anxieties about making mistakes in an emergency and markedly increases participants' willingness to help [2,13,14].

Lifesaver

Lifesaver (www.life-saver.org.uk) is an innovative, immersive, and interactive game that can be played for free on smartphones, tablets or online. The novel 'game-in-film' format provides an engaging learning experience with real life scenarios. Users become actively involved with the resuscitation of a victim of cardiac arrest and move their device up and down to simulate cardiac compressions. If a wrong decision is made, the user sees the impact but is then able to rewind and make the correct decision. It was produced by Resuscitation Council (UK) using charitable funds and generates no financial income.

Study aims

To compare the effect of Lifesaver training only, face-to-face (F2F) training only, and a combination of Lifesaver and F2F training with regard to:

Primary outcomes:

- chest compression depth (mm) and rate (compressions per minute)

Secondary outcomes:

- flow fraction – percentage of time where compressions given (recommended >60% for single-handed CPR to improve patient outcomes) [15]
- CPR score, including whether CPR was successfully achieved – maximum score of 10, using the European Resuscitation Council CPR/AED-P course assessment document (Appendix A in Supplementary material)
- attitudes toward resuscitation

Methods

Trial design and setting

The study design was a three-armed randomised controlled trial. The participating schools held Academy status (state-funded schools directly funded by the Department for Education and independent of local authority control thus giving greater flexibility to deliver training during school time). To be included, they also had to commit to three study visits and be willing to provide written informed consent. A convenience sample of one class of school children per school was used for each arm. The primary and secondary outcomes used are detailed above.

All Academy schools within the central Birmingham area were eligible to participate except those who were already participating in an established school CPR training programme (e.g. British Heart Foundation 'Heartstart'). Letters of invitation were posted to eligible schools in the area and the first three schools that responded were selected.

One class of Year 8 students (12–13 years old) from each of the three participating secondary schools was selected by their head teacher based upon timetabling requirements. Each school was randomised to group intervention using electronic random number generation:

School 1: standardised F2F BLS training only;
School 2: Lifesaver training only;
School 3: Lifesaver training in addition to standardised F2F BLS training.

Study information sheets detailing the background, aim and methods were posted to parents and signed consent forms were collected prior to student participation. Parents were asked to discuss participation with their child before giving consent on their behalf. Verbal consent from students was also collected on each occasion before students were assessed. The study was approved by the University of Birmingham Ethics Committee.

Study interventions

A standardised approach was developed and delivered to all groups by a member of the research team (DH), who is a trained BLS instructor. Each training session commenced with a short introduction about sudden cardiac arrest and the need for timely and good quality bystander CPR.

Group 1–F2F instructor led training session only

The F2F element was standardised. Each pupil took turns practicing BLS skills on a manikin. The ratio of instructors to pupils was 1:6 to ensure that adequate time and attention was given to each pupil.

Group 2 – Lifesaver only training session

The Lifesaver programme was introduced and pupils were provided with a handheld tablet to complete the programme. No additional F2F instruction or practical hands-on training (other than use of Lifesaver) was provided.

Group 3 – Lifesaver and F2F instructor led training session

The Lifesaver programme was introduced and pupils were provided with a handheld tablet to complete the programme for the same exposure time as Group 2. Pupils were then rotated to an instructor led session with a standardised F2F element which followed the same format and exposure time as Group 1.

Data collection

Baseline knowledge and attitude

Baseline data on knowledge and attitude towards performing bystander CPR was collected for all three groups by questionnaire prior to any educational intervention. The attitudes questionnaire included four statements with five-point Likert type scale answers (Appendix B in Supplementary material). Higher scores were awarded for positive attitudinal answers. Each group also completed a written knowledge test consisting of eight multiple choice questions, with one correct answer per question, covering the topics represented in both Lifesaver and the F2F course

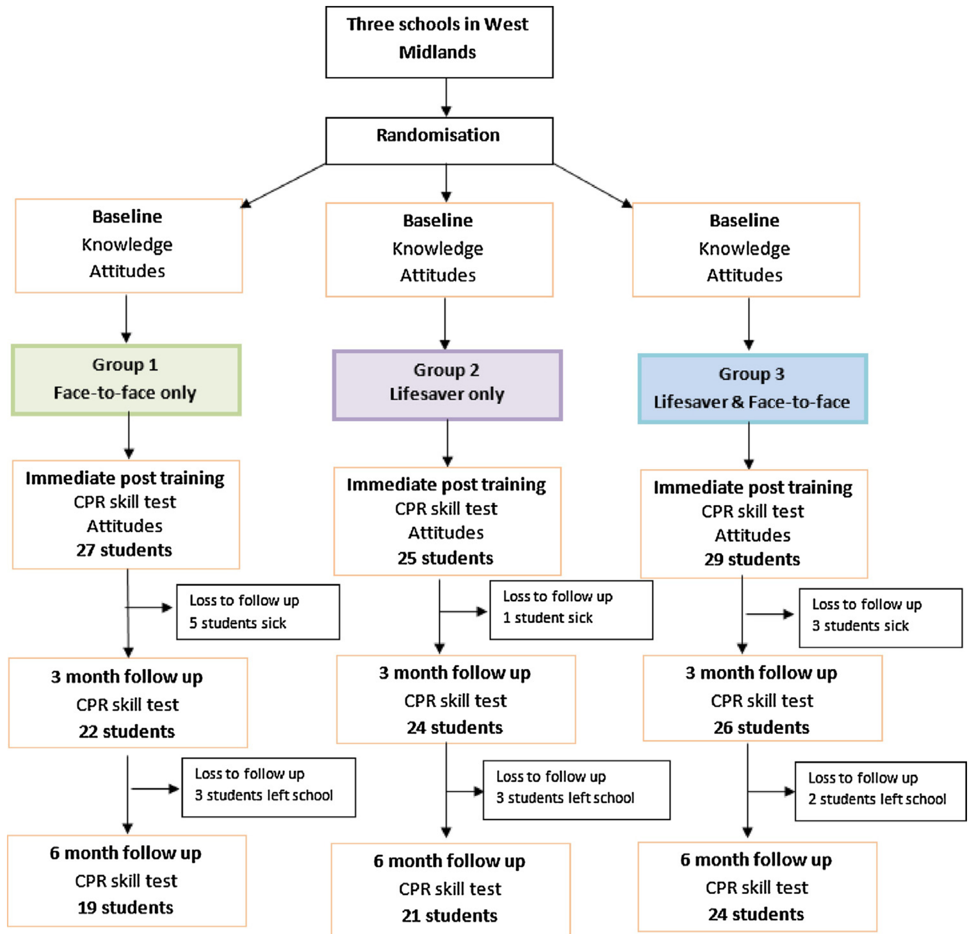

Fig. 1. Study Flow Chart.

Table 1
Group sizes and baseline knowledge.

	Group 1 (F2F only)	Group 2 (Lifesaver only)	Group 3 (Combined)
Number of students	27	25	29
Number of male students (%)	9 (33.3%)	13 (52.0%)	14 (48.3%)
Written knowledge test (out of 8)Mean ± SD	3.13 ± 0.95	3.30 ± 1.56	2.55 ± 1.09

(Appendix C in Supplementary material). These questionnaires were developed with input from a lay person who is a schoolteacher and the NIHR Clinical Research Network West Midlands Young Persons' Steering Group to ensure that questions were clear and suitable for Year 8 students.

Immediate post intervention

Students were asked to demonstrate CPR skills on manikins immediately following training and they were assessed by independent BLS trained assessors (medical students from the University of Birmingham). Each student received a scenario in which a person, represented by the manikin, was lying on the floor. They were asked to demonstrate what they would do to help. Whilst the assessors were not truly blind to the intervention, they were independent to the study. The assessors used standardized CPR assessment forms to assess the skills of each student (Appendix A in Supplementary material). All interactions between students and the manikin, including chest compression parameters, were recorded using Resusci Anne SkillReporter™ software (Laerdal Medical, Norway) and collected by remote laptop for analysis. No feedback was given to any student during or after testing.

Skill retention and follow up

CPR skill performance was tested at 3 and 6 months after initial training by identical scenarios and practical demonstration of CPR skills on manikins. Performance was again assessed by independent assessors. During follow up, students were asked if they had an opportunity to use their skills and if so, to describe their experience.

Statistical analysis

Data were analysed separately by members of the research team blinded to group allocation (IK and JY). Statistical analyses were performed using SPSS version 21.0. Normality of data was checked using the Kolmogorov-Smirnov Z test. Differences between the three groups in chest compression parameters and CPR assessment performance data were analysed using one-way ANOVA and Tukey HSD test.

Results

Eighty-one children from three participating schools were recruited into the study (Fig. 1). Twenty-seven had F2F only training, twenty-five students received Lifesaver training only, and

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twenty-nine had both Lifesaver and F2F training. The participant numbers in each group differed slightly due to the size of class taking part.

None of the students who participated had to perform CPR in real life during the study period.

Participants were aged between 12 and 13 years old. There were 9 boys (33.3%) in the Lifesaver only group, 13 (52%) in the F2F group, and 14 (48.3%) in the combined group. Initial training and assessments took place in April 2016, with 3 and 6-month follow-up in July and October 2016. No further training or feedback on CPR performance was provided after the initial allocated training. Due to some school children being off sick and changing schools during the intervening summer holidays, there was a small loss of follow-up across all three groups. The students who missed the 3 month follow up were excluded from the 6-month assessment.

Baseline knowledge (Table 1)

There was no significant difference in baseline knowledge between the three groups (F2F only mean score 3.13 (SD 0.95), Lifesaver only mean score 3.30 (SD 1.56), Combined mean score 2.55 (SD 1.09), p = 0.067) .

Primary outcomes – quality of chest compressions (Table 2)

For the primary outcome of mean chest compression depth, the Lifesaver group performed the worst at initial assessment (-11.676 compared with F2F; p = 0.0001, −16.13 compared with combined; p = 0.0001). Thereafter, Lifesaver was comparable to the F2F group at 3 months (-3.35; p = 0.493) and 6 months (-2.07; p = 0.809).

The combined group outperformed Lifesaver at all time points for compression depth. Overall there was little difference between F2F only and the combined group for compression depth except for the 6-month interval for depth (p = 0.009). Chest compression depth in F2F only and the combined group suffered from attrition at 3 months but improved at 6 months. In contrast, chest compression depth appeared to improve over 6 months for the Lifesaver only group. Overall, mean chest compression depth was shallower than the recommended depth of 50–60 mm according to European Guidelines across all time points in all groups [15].

For the primary outcome of chest compression rate, all three groups performed close to recommended rates of 100–120 compressions/minute [15]. There was no significant difference between Lifesaver only and the combined group for compression rate immediately following training however the Lifesaver only group outperformed the combined group thereafter (3 months difference +19.5 p = 0.043; 6 months difference +16.23 p = 0.024). The changes over time were similar across all groups, with a slight drop in rate, but this did not differ significantly between groups (F = 0.927; p = 0.451).

Secondary outcomes (Tables 2 and 3)

All participants managed to perform CPR with flow fraction above 60% immediately after training, with Lifesaver only highest at 80.33% compared to 73.55% in F2F only and 64.09% in the combined group. Flow fraction deteriorated during follow-up across all groups but the deterioration was slowest in the combined group (F = 4.874, p = 0.001) .

The combined group performed the best for the CPR assessment score and also the proportion of students who were assessed to have achieved adequate CPR by the assessors. The superior assessment scores and rates of CPR achievement were seen at both skill acquisition stage and up to 6 months post training. There was a significant difference at all time points both in the CPR score and the CPR achievement in favour of the combined group when compared with F2F and Lifesaver only.

Attitudes towards resuscitation improved significantly in all three groups after training (F2F p = 0.0016, Lifesaver p = 0.0266, combined p < 0.0001). The highest attitude score after training was in the Lifesaver group (17.04 ± 2.07).

Discussion

To date there have been no comparative studies investigating the use of immersive interactive scenario training as a standalone education tool or in combination with F2F instructor-led training. This study endeavours to fill that gap. The results from this study suggest that Lifesaver has a potential role to play in the education of school children in life support skills.

The most important metrics regarding successful CPR, and therefore our primary outcome measures, were the chest compression rate and depth. For the outcome of chest compression depth, the Lifesaver group performed the worst on initial assessment. Students exposed to F2F only training performed better than the Lifesaver only group immediately following training. There was no difference at 3 and 6-month follow up for compression depth between these two groups. Chest compression depth improved consistently in the Lifesaver group, which may reflect the opportunities to independently access the programme for refresher sessions in the interim.

None of the groups at any time point achieved compression depths compliant with international guideline recommendations (40–50 mm). The ability of children to deliver guideline compliant compression depth is dependent upon their age and weight. Previous studies have documented mean compression depths for 13-year-old children ranging between 24.5 mm (SD 4.5) [16] and 35 mm (SD 7.8) [17]. These findings are comparable to our reported data. We feel that it is still important to train children according to guideline compliant depths as they are more likely to remember and achieve these depths as they mature.

There was no significant difference in performance between students in the Lifesaver group compared with the F2F only group in terms of compression rate.

When comparing the Lifesaver group with the face-to-face group for the secondary outcomes, the F2F group scored significantly better on the immediate CPR score and CPR achievement score. Thereafter, there was no difference between the two groups. This may once again reflect the ability for students to revisit the Lifesaver training as often as they wanted in the intervening time.

The implication therefore is that exposure to Lifesaver only may be as effective as F2F training for most aspects of CPR performance. The true benefit however for Lifesaver is in its combination with F2F training. The combined group demonstrated superiority over F2F training alone in chest compression depth at 6 months, CPR score (at all time points), CPR achievement score (at all time points) and attitude. Not surprisingly, the combined group also demonstrated superiority compared with the Lifesaver group for many of the outcomes, although the Lifesaver group performed better regarding chest compression rate.

One of the key interactive components of Lifesaver is the direct real-time feedback given to the user if their compression rate is correct. A new virtual reality version released in 2017 has also built in feedback based upon compression depth which may further enhance performance. Lifesaver has the added advantage that it can be used for ongoing reinforcement of the principles learnt in the face-to-face teaching session. Whilst we did not specifically collate information about frequency of use during the six months, it has the potential to provide that reinforcement.

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Table 2
Primary and Secondary Outcome measures.

Outcome	Time points	Group 1 (F2F only)	Group 2 (Lifesaver only)	Group 3 (Combined)	Lifesaver only vs F2F only		Combined vs Lifesaver only		Combined vs F2F only	
					Difference (95%CI)	P value	Difference (95%CI)	P value	Difference (95%CI)	P value
Chest compression depth, mm Mean ± SD	Immediate	37.35 ± 2.48	26.44 ± 2.40	42.09 ± 1.61	-11.676 (-18.34 to −5.01)	0.0001	16.13 (9.77–22.49)	0.0001	4.45 (-2.05 to 10.95)	0.237
	3 months	32.35 ± 2.37	30.44 ± 2.58	37.39 ± 1.79	-3.35 (-10.40 to 3.69)	0.493	8.13 (1.44–14.81)	0.013	4.78 (-2.08 to 11.63)	0.224
	6 months	32.50 ± 2.23	32.56 ± 3.06	41.96 ± 1.86	-2.07 (-10.07 to 5.93)	0.809	11.84 (4.33–19.35)	0.001	9.77 (2.15–17.39)	0.009
Chest compression rate, no./min Mean ± SD	Immediate	116.05 ± 5.9	125.17 ± 5.73	117.61 ± 4.57	-11.89 (-30.39 to 6.61)	0.280	0.25 (-17.40 to 17.90)	0.999	-11.64 (-29.68 to 6.39)	0.277
	3 months	113.75 ± 7.56	119.44 ± 5.14	97.91 ± 5.53	1.876 (-18.17 to 21.92)	0.973	-19.50 (-38.51 to −0.48)	0.043	-17.62 (-37.11 to 1.87)	0.084
	6 months	113.95 ± 4.81	115.72 ± 4.63	100.13 ± 4.56	2.67 (-12.77 to 18.11)	0.910	-16.23 (-30.77 to −1.78)	0.024	-13.60 −28.30 to 1.09)	0.075
Flow fraction Mean ± SD	Immediate	73.55 ± 4.27	80.33 ± 4.5	64.09 ± 3.98	3.42 (-10.29 to 17.12)	0.823	-11.16 (-24.23 to 1.92)	0.110	-7.74 (-21.10 to 5.62)	0.354
	3 months	54.10 ± 4.89	60.67 ± 5.15	61.78 ± 4.56	3.01 (-13.11 to 19.14)	0.895	5.11 (-10.18 to 20.41)	0.703	8.13 (-7.55 to 23.80)	0.432
	6 months	48.90 ± 3.54	42.33 ± 3.74	57.04 ± 3.30	-9.52 (-21.47 to 2.43)	0.144	17.81 (6.59–29.03)	0.001	8.29 (-3.08 to 19.67)	0.195
CPR score (out of 10)	Immediate	5.95 ± 2.09	3.86 ± 1.82	7.91 ± 1.78	-2.26 (-3.53 to −0.99)	0.0001	4.02 (2.81–5.22)	0.001	1.76 (0.51–3.00)	0.003
	3 months	3.90 ± 2.24	4.14 ± 2.41	6.17 ± 1.97	0.02 (-1.52 to 1.56)	0.999	2.31 (0.84–3.79)	0.001	2.33 (0.80–3.86)	0.001
	6 months	4.35 ± 2.68	4.71 ± 2.45	6.26 ± 2.44	0.04 (-1.80 to 1.88)	0.998	1.92 (0.19–3.64)	0.026	1.96 (0.17–3.75)	0.029
CPR achieved, no./total no, (%)[a]	Immediate	14/24 (58.3)	4/16 (25.0)	22/24 (91.7)	-0.0.33 (-0.66 to 0.01)	0.043	0.67 (0.34–0.99)	0.0001	0.33 (0.04–0.62)	0.02
	3 months	8/22 (36.4)	10/24 (41.6)	19/26 (73.1)	0.03 (-0.03 to.0.37)	0.964	0.33 (0.01–0.65)	0.043	0.37 (0.03–0.70)	0.028
	6 months	7/19 (36.8)	10/21 (47.6)	19/24 (79.2)	0.11 (-0.025 to 0.47)	0.752	0.32 (−0.02 to 0.65)	0.073	0.42 (0.07–0.77)	0.014

[a] CPR achievement assessment only performed in students who managed to perform CPR skills. All student data analysed in other categories.

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Table 3
Attitude scores.

Time points	Question	Group 1 (F2F only)	Group 2 (Lifesaver only)	Group 3 (Combined)	Lifesaver only vs F2F only		Combined vs Lifesaver only		Combined vs F2F only	
					Difference (95%CI)	P value	Difference (95%CI)	P value	Difference (95%CI)	P value
Pre-training	1 (out of 5)	2.88 ± 1.08	4.07 ± 0.84	2.78 ± 1.01	-0.10 (-0.75 to 0.56)	0.933	1.29 (0.67–1.91)	0.0001	1.19 (0.55–1.84)	0.0001
	2 (out of 5)	2.96 ± 1.00	3.76 ± 1.06	2.96 ± 0.86	0.01 (-0.65 to 0.66)	0.999	0.80 (0.17–1.42)	0.009	0.80 (0.16–1.44)	0.011
	3 (out of 5)	2.92 ± 1.10	2.93 ± 1.36	2.7 ± 1.07	-2.13 (-1.01 to 0.39)	0.800	0.227 (-0.53 to 0.99)	0.756	0.01 (-0.77 to 0.80)	0.999
	4 (out of 5)	4.42 ± 0.72	4.83 ± 0.38	4.41 ± 1.12	-0.01 (-0.54 to 0.52)	0.999	0.42 (-0.09 to 0.93)	0.124	0.41 (-0.11 to 0.93)	0.152
	Total (out of 20)	13.17 ± 2.66	15.59 ± 2.40	12.83 ± 2.71	-3.15 (-2.05 to 1.42)	0.902	2.73 (1.08–4.39)	0.0001	2.42 (0.71–4.13)	0.003
Immediately after training	1 (out of 5)	4.13 ± 0.74	4.69 ± 4.7	4.04 ± 0.61	-0.09 (-0.05 to 0.33)	0.879	0.65 (0.24–1.06)	0.001	0.57 (0.15–0.98)	0.005
	2 (out of 5)	3.54 ± 1.10	3.85 ± 1.29	3.56 ± 1.04	0.18 (-0.77 to 0.81)	0.998	0.29 (-0.49 to 1.06)	0.650	0.30 (-0.48 to 1.08)	0.621
	3 (out of 5)	2.71 ± 1.08	3.54 ± 1.14	3.80 ± 0.91	1.09 (0.37–1.81)	0.001	-0.262 (-0.97 to 0.44)	0.649	0.83 (0.12–1.54)	0.018
	4 (out of 5)	4.75 ± 0.53	4.96 ± 0.20	4.92 ± 0.40	0.17 (-0.10 to 0.44)	0.296	0.04 (-0.22 to 0.31)	0.926	0.21 (-0.06 to 0.48)	0.15
	Total (out of 20)	15.12 ± 1.48	17.04 ± 2.07	16.32 ± 1.95	1.20 (-0.08 to 2.46)	0.070	0.72 (-0.53 to 1.97)	0.357	1.91 (0.65–3.17)	0.001
Difference in total pre and post training (95% CI; p value)		+1.950 (0.77–3.13) p = 0.0016	+1.450 (0.18–2.72) p = 0.0266	+3.490 (2.25–4.73) p < 0.0001						

Q1–I feel I am capable to help someone who is having a cardiac arrest (higher scores for strongly agree).
Q2–I would be scared to perform CPR (lower scores for strongly agree).
Q3–I am not willing to provide mouth to mouth breaths to a stranger (lower scores for strongly agree).
Q4–CPR should be taught in all schools in the UK (higher scores for strongly agree).
Total – higher scores equate to positive attitudes to delivery of CPR.

The benefit of Lifesaver is that it does not need any additional equipment (e.g. manikins). It is not reliant on pre-booked instructor time and it has the potential to reach into all elements of society, particularly those usually difficult to reach by F2F means. As opposed to fixed training sessions, Lifesaver enables the user to refresh their training at their convenience as frequently as they require. The Education section of the 2015 European Resuscitation Guidelines [24] recommended high frequency low dose updates to prevent the skills decay that normally occur within 3–12 months after BLS training. In addition to its potential use in initial training, Lifesaver is therefore an ideal vector to deliver this type of retraining.

Other studies have analysed the impact of 'serious gaming' to prepare students for CPR training. Creutzfeldt et al. [18–20] utilised multiplayer virtual world technology with avatars in a full-scale CPR simulation and found improved adherence to guidelines and correct frequency of chest compressions. Semeraro et al. [21,22] assessed the feedback from the use of a mini-virtual reality enhanced manikin (Mini-VREM) and found that it improved the quality of chest compression rate and depth when compared with no feedback. Semeraro et al. [23] also reported the positive impact of an online game called Relive on chest compression rate, depth, and also theoretical knowledge.

There are several limitations with this study. The numbers studied were small and this means that the results are suggestive of trends rather than definitive proof. There was also a small loss to follow up. Academy schools from one only region of the country were included and the results may not reflect performance in other parts of the UK. The study would have been strengthened if we had randomised at an individual level. The decision to analyse the three arms of the study in separate schools was made to avoid contamination of the trial intervention (e.g. friends from other classes sharing the Lifesaver product with colleagues in the F2F only group). The results cannot be generalised to other age groups. The purpose of this study was a proof of concept and it is essential that further studies now build upon this work.

Conclusions

Use of the Lifesaver programme by school children, compared to F2F training alone, can lead to comparable learning outcomes for several key elements of successful CPR. Whilst children of this age are physically unable to achieve guideline compliant compression depths, they should still be taught the correct depth as they will gain the ability to achieve this as they mature. This is a concept that may require further research.

The use of Lifesaver should therefore be considered where resources or time do not permit formal F2F training sessions. Most importantly, it helps to raise awareness of the importance of CPR and promotes a positive attitude to helping others when faced with such an emergency. From this perspective, it is potentially better than receiving no training at all. The true benefits of Lifesaver can be realised however if it is paired with F2F training.

Conflict of interest statement

Dr Lockey is a co-creator of Lifesaver. He helped to devise the research project but thereafter had no direct input or contact with any of the training, assessment, data collection or data analysis and interpretation.

No other conflicts of interest declared.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.resuscitation.2017.08.010.

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