Exploring Medical Students' Self-Reported Confidence and Willingness Administering Basic Life Support (BLS) Following Peer-Led Training in the Context of COVID-19

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ABSTRACT

Background: Basic life support (BLS) delivery improves prognosis following out-of-hospital cardiac arrest and forms an integral part of undergraduate medical curricula, although limited literature has assessed student confidence in utilizing these skills. An investigation of medical students' self-reported confidence and hypothetical willingness to perform BLS was undertaken at the University of Bristol, within its peer-led BLS training scheme (RMD Bristol). Due to the study timing including COVID-19 restrictions (2020–21), changes in student confidence during this period could also be explored.

Methods: A prospective cohort study of medical students participating in BLS training during 2018–2022 (N = 1084) was undertaken. Self-reported confidence and hypothetical willingness to perform BLS was assessed using pre- and post-training questionnaires (five-point Likert scale). Data were analyzed in three groups: 1) pre-COVID (including in-person training), 2) during COVID (virtual-only training), and 3) post-COVID (including in-person training).

Results: 347 medical students completed 658 questionnaire responses. All training modes significantly increased self-reported confidence and hypothetical willingness to perform BLS ($p < 0.05$). Self-reported confidence reduced rapidly following virtual-only training. During the pandemic, a reduction in student-perceived willingness to provide BLS in an emergency was observed in a community but not a hospital setting.

Conclusion: Peer-led BLS training is effective in improving medical students' self-reported confidence and willingness to administer BLS, regardless of delivery mode. The COVID-19 pandemic influenced both the delivery of teaching and students' attitudes towards performing BLS. Due to the rapid confidence fade after virtual-only training, BLS teaching with an in-person component may remain the most effective model for training medical students.

KEYWORDS:
Basic Life Support (BLS); medical students; peer teaching; COVID-19; confidence study

MOTS CLÉS:
Support de base (BLS); étudiants en médecine; pair enseignement; COVID 19; étude de confiance

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ABSTRAITE

Contexte: L'administration des soins immédiats en réanimation (SIR) améliore le pronostic après un arrêt cardiaque extrahospitalier et fait partie intégrante des programmes d'études médicales de premier cycle, mais peu d'études ont évalué la confiance des étudiants dans l'utilisation de ces compétences. Une étude sur la confiance déclarée des étudiants en médecine et leur volonté hypothétique de pratiquer les SIR a été entreprise à l'Université de Bristol, dans le cadre de son programme de formation SIR dirigé par des pairs (RMD Bristol). Le calendrier de l'étude incluant les restrictions du COVID-19 (2020–21), les changements dans la confiance des étudiants au cours de cette période ont également pu être explorés.

Méthodes: Une étude de cohorte prospective des étudiants en médecine qui ont suivi une formation SIR entre 2018 et 2022 (N = 1084) a été entreprise. La confiance auto déclarée et la volonté hypothétique de pratiquer les SIR ont été évaluées à l'aide de questionnaires avant et après la formation (échelle de Likert en 5 points). Les données ont été analysées en trois groupes : 1) pré-COVID (y compris la formation en personne), 2) pendant COVID (formation virtuelle uniquement) et 3) post-COVID (y compris la formation en personne).

Résultats: 347 étudiants en médecine ont répondu à 658 questionnaires. Tous les modes de formation ont augmenté de manière significative la confiance déclarée et la volonté hypothétique d'effectuer les SIR ($p < 0,05$). La confiance déclarée a diminué rapidement après une formation uniquement virtuelle. Pendant la pandémie, une réduction de la volonté perçue par les étudiants de fournir des soins d'urgence a été observée dans un contexte communautaire mais pas dans un contexte hospitalier.

Conclusion: La formation SIR menée par les pairs est efficace pour améliorer la confiance déclarée des étudiants en médecine et leur volonté de fournir les SIR, quel que soit le mode de formation. La pandémie de COVID-19 a influencé à la fois l'enseignement et l'attitude des étudiants à l'égard du BLS. En raison de la perte de confiance rapide après une formation uniquement virtuelle, l'enseignement des SIR avec une composante en personne peut rester le modèle le plus efficace pour la formation des étudiants en médecine.

抽象的

背景: 基本生命支援術（BLS）的施行改善了院外心臟驟停的預後，也是大學醫學課程的重要組成部分，但有關評估學生運用這些技能的信心的文獻卻很有限。布里斯托大學在其同伴引導BLS培訓計劃（RMD Bristol）中進行了一項關於醫學生自我報告在施行BLS的信心和意願的調查。由於研究期包括了COVID-19限制的時段（2020－21），因此可以同時探討於此期間學生信心的變化。

方法: 使用了前瞻性隊列的研究方法，而研究對象是在2018年至2022年進行了BLS培訓的醫學生（N = 1084）。利用培訓前和培訓後問卷（5點李克特量表）來評估他們自我報告的信心和意願。資料分析分爲三組：1）COVID之前（包括面授培訓），2）COVID期間（僅虛擬培訓），3）COVID之後（包括面授培訓）

結果: 共有347名醫學生完成了658份問卷回答。結果顯示所有培訓方式都能顯著提高施行BLS的自信心和意願（$p < 0.05$）。而自我報告的信心在只接受虛擬培訓後有迅速降低的現象。另觀察所得，在大流行期間，如遇上緊急情況，學生在社區環境下施行BLS的意願有所下降，但在醫院環境下並未觀察到這種情況

結論: 不論何種培訓方式，同伴引導的BLS培訓有效地提高了醫學生施行BLS的信心和意願。COVID-19大流行影響了教學的方式和學生對施行BLS的態度。由於學生的信心在僅接受虛擬培訓後迅速消退，帶有面授形式的BLS教學可能仍然是培訓醫學生最有效的模式

背景: 基本生命支持术（BLS）的进行改善了院外心脏骤停的预后，也是医学本科课程的重要组成部分，但评估学生运用这些技能的信心的文献却很有限。布里斯托大学在同伴引导BLS培训计划（RMD Bristol）中进行了一项医学生自我报告在进行BLS时的信心和意愿的调查。基于研究期间包括了COVID-19限制的时段（2020－21），因此还可以探讨在此期间学生信心的变化

方法: 使用了前瞻性队列的研究方法，而研究对象是在2018年至2022年进行了BLS培训的医学生（N = 1084）。利用培训前和培训后问卷（5点李克特量表）来评估他们自我报告的信心和意愿。信息分析分为三组：1）COVID之前（包括面授培训），2）COVID期间（仅虚拟培训），3）COVID之后（包括面授培训）

结果: 共有347名医学生完成了658份问卷回答。结果显示所有培训方式都能显著提高进行BLS的自信心和意愿（$p < 0.05$）。而自我报告的信心在只接受虚拟培训后有迅速降低的现象。另就观察所见，在大流行期间，如遇上紧急情况，学生在社区环境下进行BLS的意愿有所下降，但在医院环境下没有观察到这种情况

结论: 不论何种培训方式，同伴引导的BLS培训有效地提高了医学生进行BLS的信心和意愿。COVID-19大流行影响了教学的方式和学生对进行BLS的态度。基于学生的信心在仅接受虚拟培训后迅速消退，带有面授形式的BLS教学可能仍然是培训医学生最有效的模式

Out-of-hospital cardiac arrest (OOHCA) is a major public health issue worldwide, with rates of survival to hospital discharge remaining around 10% (Yu et al., 2020). Since the outbreak of the COVID-19 pandemic, the incidence of OOHCA has risen more than two-fold, while rates of bystander cardiopulmonary resuscitation (CPR) have decreased (Lim et al., 2020). This reduction is likely to be multifactorial but is thought to be predominantly due to increased fear of contracting an infectious disease, such as COVID-19 (Baldi et al., 2020; Lim et al., 2020; Uy-Evanado et al., 2021). The provision of first aid, including basic life support (BLS) by bystanders, before the arrival of emergency medical services, is a critical step in the chain of survival behaviors, and results in improved neurological function and lower all-cause mortality (Giacoppo, 2019; Kragholm et al., 2017; Yan et al., 2020). There is substantial global variation in the provision of bystander CPR (Shekhar & Narula, 2022; Yan et al., 2020; Yu et al., 2020), and countries with lower rates suffer decreased survival following OOHCA (Yan et al., 2020).

BLS SKILLS CONFIDENCE

Being able to recognize the need for intervention and having the confidence and willingness to administer BLS when required, are arguably at least as important as proficiency in delivering BLS skills (Abelsson et al., 2020). BLS training has been demonstrated to improve hypothetical willingness to perform bystander CPR (Blewer et al., 2020; Cho et al., 2010; Yu et al., 2020). While research has assessed the effect of BLS training on the general population's willingness to perform CPR, fewer studies have examined this effect in medical students.

The General Medical Council stipulates that doctors in the United Kingdom must provide emergency care in the community (2019). However, UK medical student BLS teaching lacks standardization and is of variable quality (Phillips & Nolan, 2001), and medical students and junior doctors can lack competence in administering BLS (de Ruijter et al., 2014; Passali et al., 2011). While medical students do not have the same professional obligation as qualified doctors (Medical Defence Union, 2022), students may feel there is a public expectation to intervene in an emergency (Xie et al., 2019). Empowering and providing medical students with the skills to administer first aid, including CPR, during an emergency is therefore of benefit to both students and the wider public.

RMD BRISTOL: PEER-LED MEDICAL STUDENT BLS TRAINING

Peer-led BLS teaching in medical schools has emerged as an effective alternative to staff-led courses (Abbas et al., 2018; Harvey et al., 2012). University of Bristol Medical School utilizes a peer-led BLS training scheme called Resuscitation Mentorship Development (RMD Bristol) for first-year medical students, based on a model first implemented by the University of Birmingham (Harvey et al., 2012). The RMD model has been previously described and shown to be highly effective in terms of teaching delivery, assessment, and supporting students through training (Gillam et al., 2023; Perkins et al., 2002). RMD

teaching follows the European Resuscitation Council's (ERC) BLS provider program, qualifying successful participants with an ERC BLS provider certificate (European Resuscitation Council, 2023). Teaching is delivered by medical student peers from years 2 to 5 of the medical program, supported by experienced qualified clinicians. All instructors complete an ERC BLS instructor course.

RMD BLS training utilizes a blended approach, with online instructional videos and a multiple-choice question quiz, followed by an in-person teaching component, with approximately five hours of total teaching time. This in-person training covers practice performing the BLS algorithm, including CPR, and automated external defibrillator (AED) use, as well as basic first aid skills, including BLS modifications for children and drowning victims, the recovery position, and treating choking. In the final session, participants are given the opportunity to practice their skills and then undertake a scenario-based summative assessment. All training is delivered using a modified version of Peyton's four-step approach; instructor demonstration, step-by-step deconstruction by instructor, formulation through instruction by students, and finally performance by students (Giacomino et al., 2020; Peyton & Walker, 1998). The course structure is outlined further in the methods section.

IMPACT OF COVID-19 ON RMD BRISTOL BLS TRAINING

Due to UK government restrictions during the COVID-19 pandemic, RMD Bristol BLS teaching was stopped in March 2020 for a period of six months. During the academic year 2020–2021, a decision was taken to change the delivery mode of BLS training to virtual-only. Teaching continued to include preparatory materials based on ERC guidelines and previously in-person components were modified for online delivery using Zoom video conferencing software (Zoom Video Communications, inc.). Virtual teaching consisted of two, two-hour sessions over a two-week period, simplified to cover BLS and AED use, and the theory behind the recovery position. The virtual-only course also used a modified version of Peyton's approach (Peyton & Walker, 1998), without the fourth 'performance' step, due to the challenges of providing all students with a resuscitation manikin and delivering adequate feedback on skills-based teaching remotely. There was no formal assessment during the virtual training and consequently no ERC certification.

Prior to the COVID-19 pandemic, in-person training components were delivered over four weeks and incorporated training on rescue breaths. Since COVID-19, training has included only the theory of delivering rescue breaths, and accordingly, the in-person component has been reduced to three weeks to reflect this reduced skills complexity. Students who missed their in-person training during the pandemic and were taught virtually, undertook full training the following year, in their second year of study.

The timing of the COVID-19 pandemic and the resulting restrictions also impacted this study. The original study design was to follow a single student year group and investigate any changes to their self-reported confidence and hypothetical willingness to deliver BLS for two years post their original BLS training (initial recruitment 2018). Due to low recruitment of students in the study during 2019 and the impact of the pandemic restrictions on teaching in March 2020, a decision was taken to pause the study. Ethical approval was then obtained to modify the study design to instead investigate a series of subsequent groups of students undertaking BLS training across four academic years between 2018–2022. The objective was changed to explore the effect of a change in delivery mode on students' confidence in performing BLS skills and to consider whether the pandemic influenced students' hypothetical willingness to administer BLS. Limitations to the study both in general and related to COVID-19 are explored further in the discussion.

STUDY AIMS

The primary aim was to investigate medical students' self-reported confidence and hypothetical willingness to perform BLS before and after their peer-led BLS training. We developed secondary aims due to the timing of the study during the COVID-19 pandemic, to assess the impact of virtual-only BLS training on medical students' confidence and willingness to deliver BLS and to examine the impact of the COVID-19 pandemic on the hypothetical willingness of medical students to intervene in an emergency. Through identifying any effect on confidence and theoretical willingness to perform BLS, we hoped to further evidence the value of the RMD BLS peer-led teaching model and its potential for wider application within and outside the field of medical education.

RESEARCH QUESTIONS

1. Are both in-person and virtual-only peer-led BLS training methods effective in improving medical student confidence and hypothetical willingness to administer BLS?
2. Does a change in delivery mode affect medical students' self-reported confidence in performing BLS skills?
3. How did the COVID-19 pandemic impact medical students' baseline self-reported confidence and hypothetical willingness to deliver BLS?

METHODS

STUDY DESIGN

A prospective cohort study was undertaken of medical students attending BLS training (N = 1084). The data collection period for the study was September 2018 to December 2021. A STROBE reporting guideline was used during the study write-up and the checklist is provided in the supplementary materials. Details of the study population are provided in Table 1.

PARTICIPANT RECRUITMENT

Student participants were informed about the study through a short presentation during their BLS training, alongside email reminders. All students undertaking BLS training were eligible to participate (N = 1084). Written informed consent was obtained via a paper or online form, and all participants answered the same questionnaire before and after their BLS teaching (completed in person in 2018–19 and online in 2019 onwards). Follow-up emails were sent out encouraging participants to complete post-course questionnaires to reduce the risk of loss to follow-up and attrition bias. Participants were made aware they were able to drop out of the study at any time before data analysis.

QUESTIONNAIRE DESIGN

A pre- and post-training questionnaire was used to assess students' self-reported confidence and hypothetical willingness to deliver BLS, using five-point Likert scale closed-questions. The four-section structured questionnaire (provided in the supplementary materials) is summarized in Table 2.

Confidence-based questions used a five-point Likert scale: 1-not at all confident, 2-somewhat confident, 3-confident, 4-very confident, 5-extremely confident, while willingness to perform BLS used a five-point Likert scale: 1-not at all likely, 2-somewhat likely, 3-likely, 4-very likely, 5-extremely likely. Likert scales have been extensively utilized for medical education research, including the use of parametric tests to analyze the responses (Sullivan & Artino, 2013). Note questionnaire section 2 gathered data on previous BLS experience, since this may influence baseline student-reported confidence and willingness.

ACADEMIC YEAR	STUDENT YEAR GROUP	YEAR GROUP SIZE	BLS TRAINING DELIVERY MODE
2018–2019	Year 1	271	Full BLS training with online learning (via ERC website) and in-person component
2019–2020*	Year 1	274	Full BLS training with online learning (via ERC website) and in-person component
2020–2021*	Year 1**	272	Virtual-only BLS training (live via Zoom)
2021–2022*	Year 2**	267	Full BLS training with online learning (via ERC website) and in-person component

Table 1 The breakdown of the study population for the research study.

Note: *Academic years affected by COVID-19: Courses were paused in March 2020 and restarted virtual-only in April–May 2021; in 2021–22 courses were swapped to compression-only CPR training.

**The same students taught BLS consecutively over two years due to COVID-19 restrictions (initially virtual-only BLS training and the subsequent year full training with an in-person component).

ERC- European Resuscitation Council.

QUESTIONNAIRE SECTION	QUESTION TOPIC	QUESTION DESIGN
1	Student number	To enable data pairing
2	Additional BLS experience	Questions to identify prior BLS training, previous BLS teaching experience, and experience performing BLS in real-life
3	Confidence in performing BLS	Four Likert-scale questions assessing student self-reported confidence in BLS skills: Q1: confidence in performing steps of the BLS algorithm correctly and efficiently (in the correct order and in a timely manner) Q2: confidence in administering effective chest compressions Q3: confidence in performing effective rescue breaths Q4: confidence performing BLS overall
4	Willingness to perform BLS	Two Likert-scale scenario-based questions to assess student hypothetical willingness to deliver BLS: Q1: in a hospital setting Q2: in a community setting

Table 2 Study questionnaire section breakdown including question topic and design.

Questionnaire data were split into three groups: 1) year 1 students taught pre-COVID including in-person training (academic year 2018–19), 2) year 1 students taught during COVID with virtual-only training (academic year 2020–21), and 3) year 2 students taught post-COVID including in-person training (academic year 2021–22). Note that Group 3 sampled students from the same population as Group 2.

Due to the change in the provision of in-person rescue breath training because of COVID-19, question 3 in section 3 of the questionnaire assessing confidence in performing rescue breaths was removed for Groups 2 and 3 and excluded from the overall analysis (see Table 2). A visual summary of the structure and content of the BLS teaching delivery for the three groups is provided in Figure 1.

DATA ANALYSIS

After the matching process, datasets were fully anonymized. Ordinal data are expressed as mean ± standard deviation (*SD*), with a 95% confidence interval (95% CI) where appropriate. The Shapiro-Wilk test was used and determined the data were not normally distributed. Data were analyzed using Microsoft Excel for Mac Version 16.71. A *p*-value of less than 0.05 was considered significant.

To determine if there was an overall impact of BLS training on medical student confidence and hypothetical willingness to perform BLS, paired pre- and post-course responses were analyzed from both Group 2 (during COVID) and Group 3 (post-COVID) using the Wilcoxon signed-rank test. Group 1 (pre-COVID) was excluded from this analysis since no paired data were available (Group 1 was lost to follow-up due to a multitude of non-systematic factors including the COVID-19 pandemic, so only pre-course questionnaire responses were obtained- see previous section on study design changes).

To assess whether any improvements in confidence and willingness to administer BLS were sustained over time following virtual-only training, an unpaired analysis of the post-course questionnaire responses from Group 2 (during COVID) and the pre-course questionnaire results from Group 3 (post-COVID) was performed using the Wilcoxon signed-rank test. For this and the above analysis, effect sizes were calculated using $z/\sqrt{n}$.

To determine if COVID-19 had impacted initial attitudes towards performing BLS, an unpaired comparison of the responses to scenarios 1 and 2 of section 4 of the pre-course questionnaires from Groups 1 and 2 was performed using the Mann-Whitney *U* test. Note, pre-course responses from Group 3 were not included in this analysis, since they were from the same student year group as Group 2 and had therefore already received virtual teaching, potentially impacting their responses.

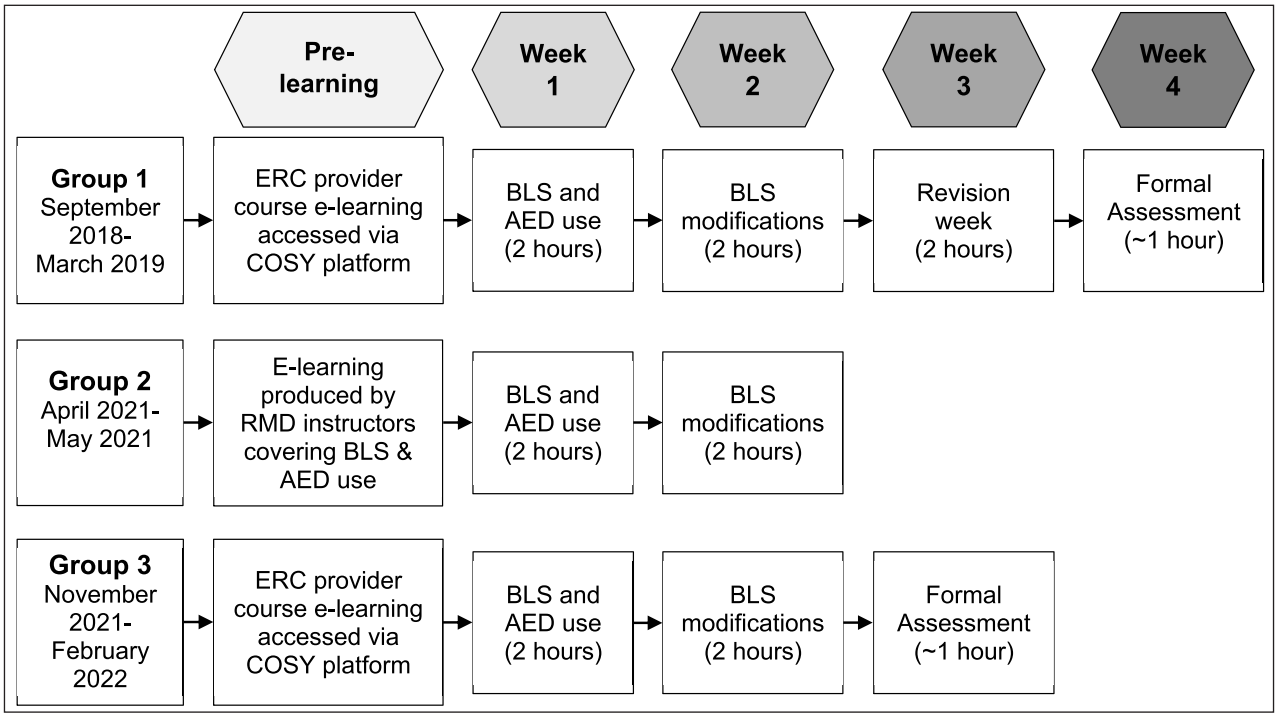

Figure 1 Flow diagram outlining the structure and content of the in-person and online components of the BLS courses.

Note: In-person teaching was delivered to study Groups 1 (pre-COVID) and 3 (post-COVID) using Peyton's (1998) four-step approach, including lectures, and small-group learning. Teaching was delivered virtually to Group 2 (during COVID) due to UK COVID-19 pandemic restrictions. This was using steps 1–3 of Peyton's four-step approach, with online lectures, and breakout groups, but no independent practice or formal assessment.

RESULTS

A total of 658 questionnaire responses were obtained from 347 students (participants, n = 347, population, N = 1084; approximate response rate = 32%) across the three study groups: 499 pre-course and 159 post-course. The total responses for each group are detailed in Table 3.

108 questionnaire responses were excluded from the paired analysis due to a lack of paired pre- and post-course responses (n = 34 excluded from Group 2, and n = 74 excluded from Group 3). Due to the low number of paired questionnaire responses and a lack of statistical power, it was not possible to directly compare Groups 2 and 3.

PRIOR BLS EXPERIENCE

A larger proportion of Group 1 (80/232; 34.4%) had received previous BLS training in the last 2 years, compared to Group 2 (40/155; 25.8%). Similarly, more students in Group 1 had previously taught BLS (10/232; 4.3%) than in Group 2 (6/155; 3.9%), and a greater proportion of Group 1 (15/232; 6.5%) had performed CPR on a real person, compared to Group 2 (7/155; 4.5%). Group 3 was excluded due to having received prior RMD Bristol BLS training.

IMPACT OF PEER-LED BLS TRAINING ON SELF-REPORTED CONFIDENCE IN DELIVERING BLS

Section 3 of the questionnaire assessed medical students' self-reported confidence in undertaking aspects of the BLS algorithm. Paired data from pre- and post-course questionnaires were compared using the Wilcoxon signed-rank test for both Group 2 (during COVID) and Group 3 (post-COVID) (see Table 4). As described in the methods section, participants in Groups 2 and 3 are from the same student year group who first undertook virtual-

GROUP NUMBER	PRE-COURSE QUESTIONNAIRE RESPONSES	POST-COURSE QUESTIONNAIRE RESPONSES	PAIRED RESPONSES TO BOTH QUESTIONNAIRES
Group 1	232	0	0
Group 2	155	121	91
Group 3	112	38	24

Table 3 The number of questionnaire responses obtained from pre- and post-medical student BLS courses from each of the experimental groups.

Note: Group 1 (pre-COVID), Group 2 (during COVID), and Group 3 (post-COVID) (n = 658 total responses).

GROUP 2 (DURING COVID): VIRTUAL-ONLY TRAINING						
CONFIDENCE DELIVERING ASPECT OF BLS	**PRE-COURSE QUESTIONNAIRE (MEAN ± *SD*)**	**POST-COURSE QUESTIONNAIRE (MEAN ± *SD*)**	***Md***	***z***	***r***	***p***
Confidence- completing BLS algorithm steps correctly and efficiently	1.95 ± 0.97 (95% CI 2.25–2.55)	3.90 ± 0.87 (95% CI 3.72–4.08)	−2.04	−7.84	0.82	<0.00001
Confidence- performing chest compressions	2.37 ± 1.05 (95% CI 2.15–2.59)	3.70 ± 0.90 (95% CI 3.51–3.89)	−1.63	−7.01	0.73	<0.00001
Overall confidence performing BLS	2.05 ± 0.99 (95% CI 1.85–2.26)	3.66 ± 0.82 (95% CI 3.49–3.83)	−0.95	−7.67	0.80	<0.00001
GROUP 3 (POST-COVID): TRAINING WITH AN IN-PERSON COMPONENT						
CONFIDENCE DELIVERING ASPECT OF BLS	**PRE-COURSE QUESTIONNAIRE (MEAN ± *SD*)**	**POST-COURSE QUESTIONNAIRE (MEAN ± *SD*)**	***Md***	***z***	***r***	***p***
Confidence- completing BLS algorithm steps correctly and efficiently	2.29 ± 0.69 (95% CI 2.25–2.55)	4.04 ± 0.80 (95% CI 3.70–4.38)	−1.71	−4.29	0.87	<0.00001
Confidence- performing chest compressions	2.29 ± 0.86 (95% CI 1.93–2.65)	3.75 ± 0.74 (95% CI 3.44–4.06)	−2.71	−3.89	0.79	0.0001
Overall confidence performing BLS	2.25 ± 0.74 (95% CI 1.94–2.56)	3.75 ± 0.68 (95% CI 3.46–4.03)	−1.75	−4.10	0.84	<0.00001

Table 4 Comparison of medical student pre- and post-course responses to questionnaire section assessing confidence in delivering aspects of the BLS algorithm, in Group 2 (during COVID), and Group 3 (post-COVID).

Note: Data were analyzed using the Wilcoxon signed-rank test. Data are presented as mean ± standard deviation (*SD*), 95% confidence interval (95% CI), mean difference (*Md*), z-value (*z*), and effect size (*r*), with p-values (*p*) of <0.05 considered significant.

only training as Group 2 during the pandemic, and then full training including an in-person component after the pandemic. A statistically significant increase in student self-reported confidence in delivering BLS was observed in both groups ($r > 0.7$ and $p < 0.05$ across all aspects). The mean post-course confidence rating was higher for all measures for the students in Group 3 who received training with an in-person component (post-COVID) compared to those reported by students in Group 2 (during COVID), who received virtual-only training (Table 4).

IMPACT OF TIME ON CONFIDENCE AND HYPOTHETICAL WILLINGNESS TO PERFORM BLS

Unpaired data from Group 2 (during COVID) and Group 3 (post-COVID), which contained students from the same year group, were compared to assess whether any changes to self-reported confidence and hypothetical willingness to deliver BLS were sustained over time, following virtual-only BLS training. The post-course questionnaires from Group 2 (taught virtual-only BLS in year 1 in 2020–21) were compared to the pre-course questionnaires from Group 3 (taught full BLS with an in-person component in year 2 in 2021–22) using the Wilcoxon signed-rank test (timing between courses 6–9 months). A significant reduction was observed in both confidence and perceived willingness to deliver BLS, demonstrating that the improvement in these scores following virtual-only BLS training was not sustained over time ($r > 0.7$ and $p < 0.05$ for all aspects) (see Table 5).

IMPACT OF PEER-LED BLS TRAINING ON HYPOTHETICAL WILLINGNESS TO PERFORM BLS

Section 4 of the questionnaire assessed medical student willingness to intervene and administer BLS in both a hypothetical hospital (scenario 1) and community (scenario 2) setting. Paired data were available from pre- and post-course questionnaires for both Groups 2 (during COVID) and 3 (post-COVID) and were analyzed using the Wilcoxon signed-rank test (see Table 6).

A statistically significant increase in student-perceived willingness to perform BLS was observed in both groups ($r \geq 0.5$ *and* $p < 0.05$ in both scenarios). The mean post-course willingness to intervene in both scenarios was higher for the students in Group 3 who received training with an in-person component (post-COVID) compared to that reported by students in Group 2 who received virtual-only training (during COVID). Students' hypothetical willingness to intervene was consistently higher in the community rather than hospital scenario (see Table 6).

IMPACT OF THE COVID-19 PANDEMIC ON PRE-COURSE HYPOTHETICAL WILLINGNESS TO PERFORM BLS

The responses to scenarios 1 and 2 of section 4 of the pre-course questionnaire were compared for Groups 1 (pre-COVID) and 2 (during COVID) using the Mann-Whitney *U* test, to see if the COVID-19 pandemic had impacted medical students' hypothetical willingness to perform BLS. For scenario 1, which assessed students' self-reported willingness to perform BLS in a hospital setting, there was no significant difference between Groups 1 and 2 (Group 1 mean 3.02; 95% CI 2.85–3.20; Group 2 mean 2.79; 95% CI 1.70–3.02; $z = 1.73$; $p = 0.08364$). For scenario 2, which assessed students' self-reported willingness to perform BLS in a community setting, students in Group 2 (during COVID) were significantly less willing to perform BLS (Group 1 mean 3.60, 95% CI 3.43–3.77; Group 2 mean 3.41, 95% CI 3.16–3.66; $z = 2.10$; $p = 0.03572$). The results are displayed in Figure 2.

QUESTIONNAIRE SECTION	POST-COURSE QUESTIONNAIRE GROUP 2 (MEAN ± *SD*)	PRE-COURSE QUESTIONNAIRE GROUP 3 (MEAN ± *SD*)	*Md*	*z*	*r*	*p*
Confidence- completing the BLS algorithm steps correctly and efficiently	3.94 ± 0.92 (95% CI 3.64–4.25)	2.22 ± 0.83 (95% CI 1.95–2.49)	2.19	–4.94	0.87	<0.00001
Confidence- performing chest compressions	3.50 ± 0.94 (95% CI 3.19–3.81)	2.17 ± 0.88 (95% CI 1.88–2.45)	1.74	–4.86	0.87	<0.00001
Overall confidence performing BLS	3.50 ± 0.85 (95% CI 3.22–3.78)	2.08 ± 0.69 (95% CI 1.86–2.31)	1.69	–4.94	0.87	<0.00001
Scenario 1: hospital setting	3.83 ± 0.85 (95% CI 3.56–4.11)	2.89 ± 1.14 (95% CI 2.52–3.26)	–0.21	–3.72	0.70	0.0002
Scenario 2: community setting	4.30 ± 0.89 (95% CI 4.01–4.60)	3.42 ± 1.29 (95% CI 2.99–3.84)	0.46	–3.49	0.71	0.00048

Table 5 Comparison of medical student responses between the post-course questionnaire of Group 2 (during COVID) and the pre-course questionnaire of Group 3 (post-COVID) to sections assessing confidence and willingness to deliver BLS, enabling assessment of whether the effects of virtual-only BLS teaching were sustained over time.

Note: Data were analyzed using the Wilcoxon signed-rank test. Data are presented as mean ± standard deviation (*SD*), 95% confidence interval (95% CI), mean difference (*Md*), z-value (*z*), and effect size (*r*), with p-values (*p*) of <0.05 considered significant.

GROUP 2 (DURING COVID): VIRTUAL-ONLY TRAINING						
WILLINGNESS TO ADMINISTER BLS IN DIFFERENT SETTINGS	**PRE-COURSE QUESTIONNAIRE (MEAN ± SD)**	**POST-COURSE QUESTIONNAIRE (MEAN ± SD)**	***Md***	***z***	***r***	***p***
Scenario 1: hospital setting	2.79 ± 1.09 (95% CI 2.56–3.02)	3.95 ± 0.90 (95% CI 3.75–4.13)	−1.21	−6.33	0.66	<0.00001
Scenario 2: community setting	3.40 ± 1.22 (95% CI 3.15–3.66)	4.32 ± 0.79 (95% CI 4.16–4.49)	−1.59	−4.74	0.50	<0.00001
GROUP 3 (POST-COVID): TRAINING WITH AN IN-PERSON COMPONENT						
WILLINGNESS TO ADMINISTER BLS IN DIFFERENT SETTINGS	**PRE-COURSE QUESTIONNAIRE (MEAN ± SD)**	**POST-COURSE QUESTIONNAIRE (MEAN ± SD)**	***Md***	***z***	***r***	***p***
Scenario 1: hospital setting	2.88 ± 1.11 (95% CI 2.40–3.35)	4.17 ± 0.82 (95% CI 3.82–4.51)	−2.12	−3.77	0.77	0.00012
Scenario 2: community setting	3.38 ± 1.38 (95% CI 2.79–3.96)	4.46 ± 0.66 (95% CI 4.18–4.74)	−0.62	−2.64	0.54	0.0083

Table 6 Comparison of medical student pre- and post-course responses to questionnaire section regarding hypothetical willingness to deliver BLS in Group 2 (during COVID) and Group 3 (post-COVID).

Note: Data were analyzed using the Wilcoxon signed-rank test. Data are presented as mean ± standard deviation (*SD*), 95% confidence interval (95% CI), mean difference (*Md*), z-value (*z*), and effect size (*r*), with p-values (*p*) of <0.05 considered significant.

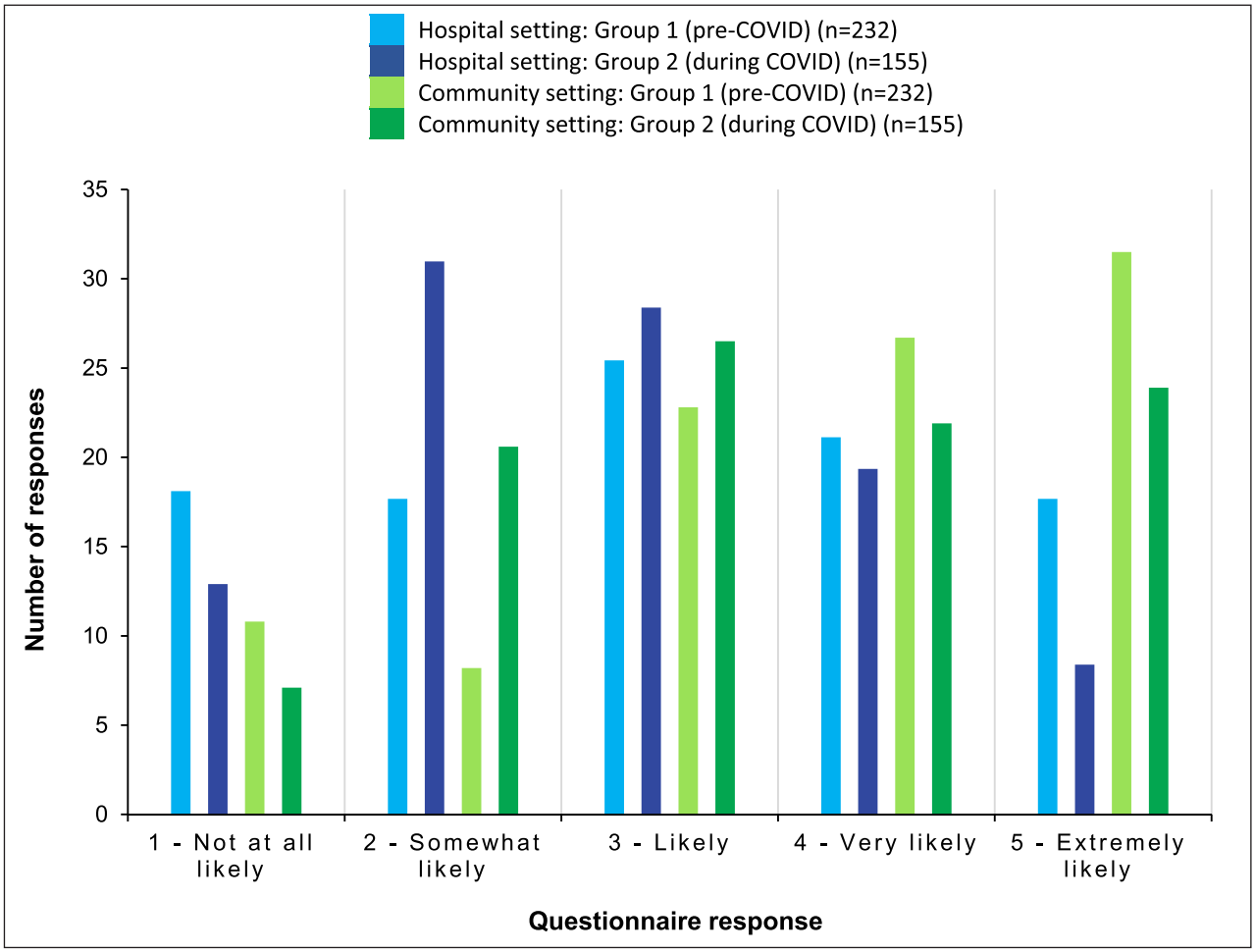

Figure 2 Medical student responses to the pre-course questionnaire scenario gauging self-reported willingness to perform BLS in both a hospital and community setting, before BLS training.

Note: Comparison of students surveyed prior to and during the COVID-19 pandemic. Responses are presented as a percentage of completed questionnaires.

DISCUSSION

This study has demonstrated that both virtual and in-person peer-led BLS teaching methods significantly increase medical students' self-reported confidence in utilizing the BLS algorithm and delivering BLS skills. Additionally, regardless of setting, peer-led BLS training results in increased hypothetical willingness for medical students to intervene in emergency situations, in both a hospital and community setting. The increase in student confidence and willingness to administer BLS was similar following both virtual and in-person courses. This corresponds with prior studies that have established the efficacy of virtual BLS teaching methods both for training healthcare professionals (Tobase et al., 2017), and the public, through resources such as the Resuscitation Council (UK) 'Lifesaver' app (Resuscitation Council (UK), 2023), and the British Heart Foundation 'RevivR' app (British Heart Foundation & Laerdal, 2023). We were unable to directly compare our groups to assess for non-inferiority of the teaching modalities, and since no formal assessment was performed after our virtual teaching, it is harder to establish whether this increased confidence and willingness translates into the ability to deliver effective BLS. It is also unknown whether the increased self-reported confidence and willingness would translate into genuine intervention in an emergency.

A significant drop in BLS self-reported confidence and hypothetical willingness to intervene was seen between the post-course questionnaire of Group 2 and the pre-course questionnaire of Group 3, in the 6–9 months between their virtual and in-person course. These groups were from the same student year group, taught during and after the resolution of UK pandemic restrictions. This suggests that the improvements in BLS confidence and willingness seen following the virtual teaching were not sustained. We hypothesize that this relatively rapid reduction in confidence and willingness may be in part due to the lack of 'hands-on' practice during the virtual course, which may have impacted students' deep learning on the topic. There remains significant support for in-person training in resuscitation skills, for example, Resuscitation Council (UK) (2020) guidance stipulates that BLS training must include the physical performance of chest compressions.

The skill degradation in our study is roughly in line with that seen in similar studies of healthcare staff (~9 months), following traditional in-person BLS teaching (Smith et al., 2008). Further research is needed to directly compare virtual only to in-person BLS training to assess its long-term efficacy. Moreover, a reduction in confidence and competence over time is not just seen following BLS training. All clinical skills training, including BLS, requires regular updates to retain the competence and confidence to perform such skills. Recognizing this, Laerdal introduced its Resuscitation Quality Improvement (RQI) program to clinical environments for healthcare staff. This supports regular interval BLS skills training, resulting in enhanced CPR skills retention, and improved clinical CPR quality (Laerdal, 2023; Panchal et al., 2020). Further study is needed to ascertain whether these pulses of increased confidence and willingness to administer BLS through programs such as RQI, or other refresher training, could be beneficial for medical students.

Our pre-course questionnaire found that when faced with a hypothetical BLS scenario, medical students were significantly less willing to act in a community setting during the COVID-19 pandemic. This corresponds with research showing an overall reduction in the rates of bystander CPR during the pandemic (Uy-Evanado et al., 2021). This study did not explore the qualitative reasons behind this finding, but it may be related to the fear of contracting COVID-19, as highlighted in the literature (Baldi et al., 2020). A further factor may have been that the students in Group 2 (during COVID) had less self-reported BLS experience prior to their training than the students in Group 1 (pre-COVID) (25.8% vs 34.4%). This lack of prior BLS experience may itself be due to COVID-19 restrictions and a potential decrease in the running of community BLS training provision. Additionally, the nature of BLS training delivery changed during the pandemic, which may have further influenced the students' viewpoint. A potential extension to this study could be to undertake a qualitative research project to investigate the reasons behind student decisions around willingness to perform BLS in different settings.

We note that mean student-reported confidence and hypothetical willingness to deliver BLS was consistently higher in the community-based scenario than for the in-hospital scenario, regardless of teaching modality, although this was not statistically compared. We hypothesize this difference may be due to reduced student familiarity and confidence in the hospital environment since they have had limited clinical exposure during the early years of their course. Additionally, their BLS training is essentially a lay-person course, meaning the focus is on community BLS. Further study is needed to explain these findings, including the qualitative reasoning behind these disparities, as well as exploring whether the reduced confidence and willingness to perform BLS in a healthcare setting remains if training is focused on the healthcare environment.

The efficacy of the BLS training for all students who took part in this research has been demonstrated through their increased confidence and perceived willingness to act if experiencing a real-life emergency. This adds to the literature that establishes peer-led BLS teaching as an effective, economical, and reliable method of training delivery for healthcare professional students. Moreover, the effectiveness of peer-led instruction has since been widely replicated across

different continents, resource settings, and learner groups (Abbas et al., 2018; Beck et al., 2015; Binkhorst et al., 2020). Peer-led teaching models may be particularly well-suited to global expansion to low-resource settings since once established they can provide a self-sustaining, low-cost teaching program, with greater availability of instructors in regions where resources may be most stretched (Harvey et al., 2012). Given the reduced rates of bystander CPR in countries with a lower GDP per capita (Shekhar & Narula, 2022), such a low-cost and easily expandable model is sorely needed to improve the substantial morbidity and mortality burden of OOHCA.

LIMITATIONS

There are limitations to this study. Group 1 was lost to follow-up due to multiple non-systematic factors, including the pandemic. This resulted in a significantly reduced number of paired responses to assess the efficacy of peer-led BLS training, impacting the statistical power of the study. This loss to follow-up prevented a true comparison of pre- and post-COVID-19 BLS teaching methods and the effect of the pandemic on medical students' self-reported confidence and willingness to deliver BLS. The sample sizes in this study were relatively small and this was a single-center study, reducing the wider generalizability of the results. The study would benefit from expansion across multiple centers that also offer peer-led BLS training. The validity of the study could also have been improved by more strictly basing the questionnaire and scenarios on previously validated models.

As discussed in the background, the timing of the COVID-19 pandemic meant that the original study design, to follow a single student cohort over time (2-year follow-up period), was disrupted. This meant the current study was not able to assess whether the observed increase in student confidence and willingness was retained over an extended period. Moreover, confidence was self-reported and did not use a specific confidence rating scale. Lastly, the questionnaire used self-assessed student willingness to administer BLS in two hypothetical scenarios, raising the question of real-life translatability.

CONCLUSION

Peer-led BLS training improves medical students' self-reported confidence and hypothetical willingness to perform BLS and intervene in an emergency, regardless of delivery method. This is important, as it demonstrates that effective BLS training can be maintained during unexpected environmental disruption, such as occurred during COVID-19. However, training including the in-person provision of BLS skills, particularly for CPR competency, remains the recommended method of instruction and continues to be used at RMD Bristol post-COVID-19.

Peer-led teaching schemes provide significant development opportunities for medical student instructors in teaching, mentoring, teamwork, and leadership. Due to the ability of peer-led schemes to deliver highly effective training at relatively reduced costs, with proven instructor reliability, and the capability to create a self-sustaining instructor pool, such models have the potential for wider expansion within and beyond medical education curricula.

DATA ACCESSIBILITY STATEMENT

The data set used in this research project is restricted as at the time of the initial project participants were not asked for their permission to share data beyond the immediate project team. Access requests can be directed to the research team at the University of Bristol.

ADDITIONAL FILE

The additional file for this article can be found as follows:

- **Supplementary Materials.** Study questionnaire and STROBE statement - checklist for cohort studies. DOI: https://doi.org/10.25894/ijfae.6.1.94.s1

ETHICS AND CONSENT

This study was undertaken at the University of Bristol under ethics approval number: 66702.

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COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

- WM was involved in the initial concept of the work, the acquisition, analysis, and interpretation of the data, and the main drafting of the manuscript.
- AR was responsible for the acquisition, analysis, or interpretation of data for the work, and the initial drafting of the manuscript.
- OK was involved in the initial concept of the work, the acquisition, analysis, and interpretation of the data, and has supported the drafting of the manuscript.
- SA was involved in supporting the original concept of the work, supported the data collection process, and critically reviewed the manuscript for intellectual content.
- MB was involved in supporting and supervising the original concept of the work and critically reviewed the manuscript for intellectual content.
- All authors have approved the final version of the manuscript to be published and agree to be accountable for all aspects of the work.

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