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Performance outcomes of an online first aid and CPR course for laypersons

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Abstract

Objective: The study evaluated the effectiveness of an online first aid course by comparing it with the traditional instructor-led course. An effective online course increases course accessibility and mitigates the major deterrent to widespread layperson training.

Design: A comparison group design evaluated performances among 25 laypersons self-selecting the traditional course and 46 self-selecting the online course.

Setting: Online participants completed the course in a location and at a time convenient to them. Traditional participants completed the course at testing sites. All attended a testing site for skills testing.

Method: Eight instructors participated in traditional course delivery, skills review and practice, and skills testing. They assessed participants' performance using standard checklists. Resuscitation mannequins captured objective performance data.

Results: Instructors assessed all participants as passing all skills tests. None passed using the objective data but online course participants outperformed traditional course participants.

Conclusions: The online course is effective. Its accessibility permits broader dissemination and use.

Keywords

CPR training, first aid training, layperson training in first aid, learning first aid, online training in first aid

The National First Aid Science Advisory Board, founded by the American Heart Association (AHA) and the American Red Cross, defines a first aid provider as someone with formal training in first aid, emergency care, or medicine, who provides first aid[1]. The Advisory Board 'strongly believe' that education in first aid should be universal[1].

The most often-cited reasons for not obtaining training include requirement to schedule and attend a class (prior planning and ease of access), the time required to complete a class (eight or more hours), and reluctance to join group learning activities (self-consciousness and concerns about performance in group settings)[2, 3].

To achieve more broad-based training in first aid, including cardiopulmonary resuscitation (CPR), requires that laypersons receive training via the most efficacious method that maximizes knowledge transfer, psychomotor skill acquisition, and retention[4, 5]. Training should be

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easily accessible, simplified, and based on the learner's personal objectives[6, 7]. The shift from the traditional instructor-led classroom format to the use of self-directed video-based instruction is one strategy to successfully accomplish these goals[8–13]. Self-directed video-based instruction includes the use of audio-visual materials presented using a medium that the learner controls, in which skills are modelled and learners practice the skills while observing them being modelled.

Recent studies examining CPR skill acquisition have consistently documented that self-directed video-based instruction or video self-instruction (VSI) for laypersons results in skill performance that is comparable to, or better than, that achieved with the traditional classroom approach[8–13]. Einspruch et al[10] also reported that retention of skills with each type of instruction was equivalent while Braslow et al[9] reported better retention with a VSI approach.

Online or internet-based CPR education has been less well studied. It has the potential for increasing high quality bystander CPR[14]. Chamberlain and Hazinski[15] advocate replacing instructors with 'facilitators who complement the new educational technology' (p. 19). They note that simulation-type CDs for use in personal computers may offer 'far more effective learning experiences than have been available until now' (p. 19).

Online CPR education incorporates many of the principles used in VSI and offers such other benefits as flexibility and consistency[16, 17]. Online CPR education eliminates one of the major concerns with traditional instructor-led courses: instructor variability[18, 19]. Its increased accessibility can also overcome many of the logistical challenges of classroom-based training as it can be adapted to almost any setting and can reach more remote populations. Online CPR education may also overcome such other impediments as anxiety or other aversive psychological responses associated with learning within classroom settings.

As part of its initiative to increase the number of persons trained in first aid, the AHA adapted its Heartsaver First Aid with CPR and automated external defibrillator (AED) course so that all content, including the knowledge exam, could be completed online at the convenience of the learner. Neither the effectiveness of the online course nor learner receptivity to it has been formally evaluated.

Purpose of the study

This study evaluated the effectiveness of the online Heartsaver First Aid with CPR and AED course by comparing first aid and CPR and AED performance outcomes of learners completing the online course with those of learners completing the traditional instructor-led course. The study was guided by the following questions

1. What differences are there in first aid and CPR and AED skills when instruction is delivered using an online computer-based approach and the traditional instructor-led classroom approach?
2. Is learner satisfaction differentially associated with the mode of course delivery?

Method

The study, approved by the university institutional review board, used a comparison group design to evaluate learning outcomes associated with the Heartsaver First Aid with CPR and AED course (first aid basics; medical, injury, and environmental emergencies; infant and adult 1-rescuer CPR; and, use of an AED) when taught online (ONLINE) and in the traditional format (TRAD). The instructional approaches differed only in how:

a) the cognitive portion was taught (classroom lecture and DVD for TRAD and Web-based, computer-accessed for ONLINE);
b) cognitive knowledge was assessed (instructor administered paper-and-pencil test for TRAD and web-based, computer accessed test for ONLINE); and
c) skills were taught (integrated into the classroom content for TRAD and instructor-guided practice following completion of the web-based computer-accessed instruction for ONLINE).

Participants

The convenience sample consisted of 71 volunteers recruited by word of mouth and flyers. They were volunteer staff in an adult free clinic, employees of social service organizations, employees of a university environmental health and safety department, faculty and staff of a university's mathematics department, and employees of a city's public works department. They ranged in age from 17 to 75 years (mean = 42, *SD* = 13, median = 43). About half (55 per cent) were female. Most (75 per cent) were white. Most (87 per cent) reported having no recent CPR experience and most (77 per cent) had not had CPR training within the past five years.

Instructors

Eight AHA-certified instructors participated in the study. Instructors' ages ranged from 20 to 56 years of age (mean = 43.5; median = 48.5; *SD* = 12) and each listed as their race/ethnicity 'White, not Hispanic'. Five were males with training as emergency medical technicians (EMTs). The three females were registered nurses (RNs). Each had performed CPR in a real emergency and, within the past five years, had taught from 10 to 100 courses (mean = 67.5; median = 67.5; *SD* = 48.7). They were compensated for delivering the course in the traditional format, staffing the skills practice opportunities for ONLINE participants, and conducting all skills tests.

Outcome measures

Three skills checklists completed by AHA certified instructors assessed participants' learning: first aid, 1-rescuer adult CPR and AED, and infant CPR. Each of these checklists is routinely used in evaluating learning at the end of the Heartsaver First Aid with CPR and AED course. Objective CPR performance data were captured by a software program written specifically for this study residing on laptops connected to the resuscitation mannequins (adult and infant) on which participants demonstrated CPR and AED skills. At the end of the study, each participant completed a survey that evaluated the participant's satisfaction with the instructional approach and his/her self-assessed level of confidence to give first aid to a friend or family member and to a stranger. The survey, designed for use in the study, contained items adapted from the AHA course evaluation forms. Each participant also completed a demographic data form.

Procedure

Once identified, individuals interested in participating were contacted by a member of the research team who described the study requirements. To increase interest in learning first aid, participants self-selected to instructional approach: traditional instructor-led (TRAD) or online computer-based (ONLINE).

Individuals selecting to participate in the ONLINE group received an identification code, instructions on how to access the AHA website, and were directed to record the total time spent on

the course. Those who completed the course at home, on campus, or at their places of employment were given a telephone number to call when they were ready for practice and skills testing. Those who came to a site in which both testing and traditional course delivery occurred arrived at the same time as those in the TRAD group. After registering, they were escorted to an area where they could work privately. After completing the online course, each participant had the opportunity to practice and/or ask questions about first aid, CPR and AED use while observed and/or guided by a certified CPR instructor. When they were ready to take the skills tests, they reported to a check-off station where a certified instructor administered the skills tests.

Individuals selecting to participate in the TRAD group arrived in groups of six to 12 at a course delivery site. After registering, they were escorted to a large classroom in which the course was delivered by AHA-certified instructors. Skills practice was instructor-supervised using individual mannequins and implemented as the course sections were taught. The number of instructors per training session adhered to a 6:1 ratio of learners to instructor, and a 1:3 ratio of instructors to mannequins. Participants in the TRAD course were assessed on first aid skills during the course. At the end of the course, each participant reported to a testing station where a certified instructor administered the CPR and AED skills tests.

All participants performed 1-rescuer adult and infant CPR and proper use of an AED on a resuscitation mannequin (Laerdal Medical Corporation, Stavanger, Norway) while being assessed by an AHA-certified instructor. The instructors used 'chain of survival' scenarios similar to those in learning modules from the AHA Heartsaver First Aid with CPR and AED course. Prior to each CPR skills test, instructors were reminded to complete the testing before offering remediation. When an instructor varied from the protocol outlined in the instructor manual, a member of the research team requested that the instructor use the protocol as detailed in the instructor manual. A member of the research team was present during the CPR and AED skills tests to capture the objective data from the resuscitation mannequins.

After successful completion of the skills tests, each participant completed the end of study survey. Each received an AHA First Aid Course completion card and was thanked for participating in the study.

Statistical analyses

All data were analyzed using SPSS 15.0 for Windows software (SPSS Inc., Chicago, IL, USA). Descriptive statistics were computed on the demographic data, the instructor-assessed performance data, the performance data from the mannequin, and the survey data. Multivariate analysis of variance examined comparability of overall outcomes associated with course format. When the multivariate analyses of variance indicated a significant group difference, the univariate analysis results were examined. Chi square was used to evaluate differences in checklist performance, satisfaction and confidence items associated with course format. All tests were evaluated using a criterion of $p \leq .05$.

Results

Twenty-five participants elected to learn first aid with CPR and AED in the traditional instructor-led format and 46 elected to learn first aid with CPR and AED in the computer-based online format. Participants in the ONLINE course reported completing the computer-based part of the course in as little as one hour to as much as nine hours (median = 3 hours).

Statistically, participants in the two groups were equivalent in terms of age, gender, race/ethnicity, number holding employment as a healthcare provider, and number holding certification in CPR. Participants electing to take the course online had significantly more education (94 per cent had more than a high school education) than did participations electing to take the traditional course (72 per cent had more than a high school education; $F = 5$, df = 1, $p > .03$).

Instructor assessed psychomotor skills performance

All participants were assessed as passing the first aid skills tests. Chi square analyses of instructor-assessed performance on first aid revealed no difference associated with instructional approach on all but one item. ONLINE participants tended to perform less well than participants in the TRAD group on the item 'Look for medical information jewellery' (66 per cent and 100 per cent respectively).

All or almost all participants were assessed as correctly performing the steps of 1-rescuer adult CPR with AED and infant CPR. Multivariate analysis of variance of instructor assessments revealed no differences in instructors's summary performance scores associated with instructional approach. Chi square analyses of differences in assessed performance on items in the checklist for adult CPR with AED revealed differences associated with instructional approach on only two items. Each item was 'give two breaths'. A significantly larger percentage of participants in the ONLINE group (100 per cent) than in the TRAD group (92 per cent) were assessed by instructors to have correctly performed the action of giving breaths (chi square = 3.7, df =1, $p < .05$). There were no differences in assessed performance on infant CPR or use of an AED associated with instructional approach.

Mannequin-assessed CPR performance

Because of technical difficulties with the laptop and software attached to the infant resuscitation mannequin, only the data on one person adult CPR and AED were analyzed. The objective CPR performance data indicated that none of the participants performed CPR effectively (see Table 1). The AHA guidelines (AHA, 2005)[1] recommend that chest compressions be delivered at a rate of 100 per minute. Each compression should depress the chest 1.5–2 inches with all pressure removed from the chest at the end of each compression to permit full chest recoil. The ratio of ventilations to compressions is recommended as two ventilations followed by 30 compressions with pauses in chest compressions to deliver ventilations (hands-off time) taking less than 10 seconds. Average minute ventilations with breaths should range between 500 and 600 L per minute.

Multivariate analysis of variance of CPR performance measures revealed significant differences associated with course format ($F = 6.2$; df = 9,58; $p = 0.00$; $\varepsilon^2 = 0.49$). The univariate analyses revealed that participants in the ONLINE group had significantly higher rates of compressions than did participants in the TRAD group ($F = 6.9$, df = 1, $p = .01$). A significantly larger percentage of compressions delivered by participants in the ONLINE group were of adequate depth when compared with the performance of participants in the TRAD group ($F = 9.5$, df = 1, $p = .00$). Participants in the ONLINE group attempted more ventilations than did participants in the TRAD group but the difference was not statistically significant. Participants in the TRAD group had significantly higher average minute volumes then did participants in the ONLINE group ($F = 5.6$, df = 1, $p = .02$). Participants in the ONLINE group had significantly higher average hands-off times than did participants in the TRAD group ($F = 15.8$, df = 1, $p = .00$).

Table 1. Skills performance as assessed by the sensorized mannequin

Performance measure	Traditional mean (*SD*)	Online mean (*SD*)
Pass	0	0
Number of correct compressions	16 (24)	11(16)
Number of compressions per minute	29 (8)	35 (10)
Percentage of compressions of adequate depth	21 (29)	50 (41)
Percentage of compressions with full release of pressure	4 (4)	9 (14)
Hands-off time (seconds)	4 (6)	23 (22)
Number of correct ventilations	2 (2)	2 (2)
Minute volume	682 (321)	474 (359)

Learner satisfaction

Learner satisfaction with the instructional approaches is summarized in Table 2. There were no differences in either learner satisfaction or confidence in helping a victim of sudden collapse associated with instructional approach.

In response to an open-ended question about what they most liked about the course, participants in the TRAD group reported that they most liked the instructors, hands-on practice, the pace of the course, the atmosphere, having multiple instructors, and the demonstration. Watching videos and little or no hands-on demonstration were things that they least liked about the course.

Participants in the ONLINE group most liked the online course scenarios/videos (‘excellent’; ‘helpful’), hands-on practice at skills check-off, working at own pace, the ability to go back and focus on weak areas, convenience, flexibility, ease of online test, time elapse between course and skills check (‘more realistic’), short tests at the end of each section, direct answers to questions at skills check off and having people there, that it was good ‘for those who get nervous in crowds’; ‘the computer for basic work really helped’; ‘wonderful programme’. Participants in the ONLINE group reported that they least liked not having hands-on training and interaction (‘would not recommend online for people doing CPR for the first time: the traditional course would help students learn better’), course too text-based, no professional there to answer questions, lack of ‘real instructors’, logging in trouble, inability to go back and check test questions, need for the manual prior to taking the online course, and ‘have to be disciplined to do online’.

Discussion

The overall pattern of the results indicates that learners in the ONLINE instructional approach performed as well as did those in the traditional instructor-led course. The results are highly similar to that reported by others comparing performance outcomes from traditional instructor-led and learner driven or self-managed courses[10, 12, 20].

Subjects in this study were permitted to self-select the approach by which they would learn CPR and most (65 per cent) elected to do so using the ONLINE approach. Both groups of learners were satisfied with the course they took and reported that the course prepared them for being successful on the performance tests. Both groups of learners were confident that they could help victims of sudden collapse.

Table 2. Learner satisfaction survey

Satisfaction measure	Traditional frequency (per cent)*	Online frequency (per cent)*
I enjoyed learning first aid in this way		
Strongly agree	19 (76)	31 (69)
Agree	6 (24)	14 (31)
I thought learning first aid in this way was effective		
Strongly agree	20 (80)	34 (76)
Agree	5 (20)	11 (24)
I thought I was prepared for the first aid check-off		
Strongly agree	19 (76)	22 (49)
Agree	6 (24)	20 (44)
Disagree	0	2 (4)
I enjoyed learning CPR with AED in this way		
Strongly agree	21 (84)	33 (73)
Agree	4 (16)	10 (22)
Disagree	0	1 (2)
I thought learning in this way was effective		
Strongly agree	21 (84)	36 (80)
Agree	4 (16)	8 (18)
Disagree	0	1 (2)
I thought I was prepared for the CPR with AED skill test		
Strongly agree	19 (76)	23 (51)
Agree	6 (24)	17 (38)
Disagree	0	4 (9)
If I witness the sudden collapse of a friend or family member:		
I know I could help	22 (88)	41 (91)
I think I could help	3 (12)	4 (9)
I'm uncertain that I could help	0	0
I don't think that I could help	0	0
I know that I could not help	0	0
If I witness the sudden collapse of someone who I do not know:		
I know I could help	20 (80)	38 (84)
I think I could help	5 (20)	7 (16)
I'm uncertain that I could help	0	0
I don't think that I could help	0	0
I know that I could not help	0	0

*Rounded to nearest tenth.

With each instructional approach, about 10 per cent of participants did not complete the course. Like the subjects studied by Roppolo et al[12], those in the traditional instructor-led course ended participation early as they had other commitments even though they had agreed to commit the time prior to enrolling in the study. Subjects in the ONLINE approach typically ended participation as a consequence of difficulty with the online programme (getting and staying online) and scheduling a time for skills testing.

Instructors assessed all participants' CPR performance as meeting the criteria for pass; but, the objective data acquired directly from the adult resuscitation mannequin revealed that none of the participants had performed effective CPR (correct compressions and ventilations). Others [18, 19, 21] have reported similar findings. Lynch, Einspruch, Nichol, & Aufderheide[21], for example, reported

that instructors' false–positive rate on compression depth was 55 per cent. Birnbaum et al[18] found that instructors excused sequencing errors and weighted assessments of ventilations more heavily than assessment of compressions.

CPR quality during the adult CPR with AED skills test was poor with each instructional approach. It was substantially poorer than that reported, for example, by Roppolo et al[12] who evaluated performance outcomes associated with a traditional Heartsaver with AED course and one using a self-directed watch-while-practicing approach (DVD). Laypersons in Roppolo's et al's[12] study delivered rates at those recommended by the AHA with 96 to 98 per cent of the compressions being of adequate depth. Even though the quality of CPR in this study was less than desired in each of the instructional approaches, ONLINE learners had a higher average rate of compressions and a larger percentage of compressions of adequate depth than did TRAD learners.

Participants in the ONLINE group were more apt to repeat ventilation attempts with the goal of visible chest rise while participants in the TRAD group tended to reposition after a failed ventilation (one that did not produce chest rise). Instructors in both traditional course delivery and skills testing emphasized chest rise as the way to judge effective ventilations. Emphasis on visible chest rise also contributed to the large average hands-off time as participants delayed delivering chest compressions at the beginning of each cycle of chest compressions. The delay in delivering chest compressions, especially during the first two minutes of resuscitation, has been reported by others[22, 23] and served as one of the factors contributing to issuance of the AHA science Advisory on compressions only CPR[24].

The major limitation of the study and its results was instructor variability. As an experienced instructor, each had developed his/her own way of doing things and each departed from the directions provided in the instructor manual. Rather than complete the modules in the course in the recommended order, some reasoned that it made more sense to complete all first aid modules and then all CPR modules. Instructors were more likely to prematurely begin coaching and offering remediation to participants in the ONLINE group. Some instructors gave scenarios which required oral responses and/or interrupted CPR delivery. Each instructor began the testing session with directions to the participant that were uniquely his/hers; none included all of the points indicated in the instructor manual. Most started with comments intended to place the learner at ease but they then failed to clearly communicate that the encounter was an evaluative one rather than an interactive one. The finding that participants in the ONLINE group were less likely than those in the TRAD group to check medical information jewellery is most likely associated with instructor emphasis.

Conclusions

Survival in out-of-hospital witnessed cardiac arrest remains low at about 6 per cent[25–27]. The key to improving survival rates is prompt delivery of first aid including calling for emergency medical assistance, delivering cardiopulmonary resuscitation (CPR), and using an automated external defibrillator (AED). Immediate bystander CPR can double or even triple chances for survival[25]; but, reported rates of bystander CPR are low – from 21 per cent in the United States[28] to 28 per cent in Japan[29]. One factor that mitigates improvement in survival is the relatively small number of bystanders trained in CPR and first aid[13].

Our results support the use of online learning as one of the multiple ways in which the inconvenience barriers attributed to poor course enrollment could be overcome. Online or internet-based learning will also reduce variability in performance outcomes arising from variability in instructor style and emphasis.

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