Original Article

A follow-up report on the effect of a simplified basic life support training program for non-medical staff working at a university hospital: changes in attitude toward cardiopulmonary resuscitation and automated external defibrillator use through repeat training

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Aim: This study aimed to investigate the effect of repeat training and the interval of reattending a simplified basic life support (BLS) training course.

Methods: We administered a questionnaire on the attitude toward cardiopulmonary resuscitation (CPR) and automated external defibrillator (AED) use (check for response, chest compression, and using an AED) before and immediately after a 45-min BLS training program provided for non-medical staff working at a university hospital from September 2010 to November 2018. The main outcome was positive willingness of the participants toward CPR and AED use. The effect of repeat training was assessed with McNemar's test and multivariable logistic regression analysis. Differences in the interval of reattending the simplified BLS training course were assessed with Fisher's exact test.

Results: Fifty-nine training courses were held. Among the total participant count of 1,025, 760 individuals attended, of whom 126 attended the training multiple times. The proportion of participants showing a positive attitude toward chest compression before the course increased as the number of attendances increased (adjusted odds ratio 1.62: 9.8% at first training to 58.8% at sixth training). The positive attitude of participants before the course was significantly greater when the training interval was <1 year (36.1% versus 18.7%). There was no significant difference for a 6-month interval (40% versus 23.2%).

Conclusions: Repeat training for non-medical staff in a chest compression-only CPR training course showed a cumulative effect of repeat attendance. A course interval of <1 year from the previous attendance would be important for maintaining a positive attitude toward CPR and AED use.

Key words: CPR training, interval, non-medical staff, repeat training, retraining

INTRODUCTION

BASIC LIFE SUPPORT (BLS), including cardiopulmonary resuscitation (CPR) and the use of an automated external defibrillator (AED), by bystanders is one of the most important factors in lifesaving care for patients with cardiac arrest.[1] Generally, most people who initially encounter a patient are of a non-medical population. Therefore,

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BLS training for non-medical people and maintaining their BLS skills are crucially important.

Many hospitals have a rapid response system that allows emergency medical teams to respond quickly to patients with cardiac arrest and to critically ill patients. Osaka University Hospital is one of the major university hospitals in Japan, and a simplified BLS training course was started in September 2010 for non-medical workers who could potentially be first responders and could activate the system in this hospital. We previously reported the effects, improvement in CPR quality, and attitude towards CPR and AED use in 2014.[2] A randomized control trial study reported that monthly training is more effective for the acquisition and retention of high-quality CPR skills.[3] Other studies recommended retraining within 6 or 7 months,[4,5] and American Heart Association course completion cards are valid for 2 years through the end of the month in which the card is issued.[6] However, the cumulative effects of attendance and feasible attendance intervals have not been investigated adequately.

Our simplified BLS training for non-medical workers has been held regularly, and participants attending the same training courses multiple times comprise one third of all attendance. The purpose of this study was to evaluate the cumulative effect of multiple attendances and to investigate an optimal and feasible attendance interval for this training course.

METHODS

Study design

THIS STUDY WAS a prospective observational study. The study period was 110 months between September 2010 and November 2018. This study was approved by the Ethics Committee of Osaka University Graduate School of Medicine (No. 10119). The targets of this study were the non-medical workers in our hospital who attended the simplified BLS training course to whom we administered a questionnaire designed to evaluate their attitude and confidence towards CPR before and immediately after the 45-min BLS training program. The question items included "Can you check for a response?", "Can you perform chest compression?", and "Can you use an AED?" (Table 1). The participants received the questionnaire survey before and immediately after the course and filled out the questionnaire anonymously; a participation certificate was exchanged for the questionnaire after each course. The questionnaire survey that addressed participants' perceptions before the course, was started after the 14th course. Because the number of participants attending more than six times was small, their results were included with those of the participants included in the sixth training.

Table 1. Questionnaire survey regarding the effect of a simplified basic life support training program for non-medical staff working at a university hospital

Q1. Can you check for a response?
I can.
I don't know if I can.
I can't.
I shouldn't. More skillful people should.
Q2. Can you perform chest compression?
I can.
I don't know if I can.
I can't.
I shouldn't. More skillful people should.
Q3. Can you use an AED?
I absolutely can.
I think I can.
I don't know if I can.
I think I can't.
I absolutely can't.

AED, automated external defibrillator.

Training program

We previously described the training course in detail.[2] Briefly, the 45-min simplified BLS training program consisted of instruction on chest compression and AED use with a personal training manikin (Table 2) that has been provided for non-medical staff working at our university hospital since September 2010. We used the CPR Training Box APPA-KUN (Fig. 1), obtained from the non-profit organization Osaka Life Support Association (Osaka, Japan), as the personal training manikin. The training program was DVD-based, and the contents of the training course were standardized by use of the DVD presentation.[2]

Main outcome

The main outcome was positive willingness of the participants toward CPR and AED use. We defined positive responses toward BLS skills in the questionnaire survey to be "I can" for the "check for response" and "chest compression" questions and "I absolutely can" or "I think I can" for the "use an AED" question.

Statistical analysis

We assessed the effect between before and after each training course with McNemar's test. To assess the effect of repeating the training course, we evaluated factors

Table 2. Time schedule of the simplified basic life support training program for non-medical staff working at a university hospital

Training schedule	Device used	Time (min)
Welcome		2
Introduction movie	DVD	6
CPR demonstration movie in-hospital	DVD	6
Instruction on checking for a response	DVD and practice	4
Instruction on simplified CPR	DVD and practice	9
Instruction on AED use	DVD and practice	7
Review	DVD and practice	8
Question and answer session	DVD and practice	3
Total		45

AED, automated external defibrillator; CPR, cardiopulmonary resuscitation; DVD, digital versatile disc.

associated with positive responses to the questionnaire survey before the training course with multivariable logistic regression analysis and calculated the adjusted odds ratio (AOR) and 95% confidential interval (CI). In the multivariable logistic regression model, we included the following variables: age, sex, and number of courses attended. We also assessed the optimal interval of attending our simplified BLS training course with Fisher's exact test by comparing the number of positive responses. We assessed less or more than 6 months and less or more than 1 year as the intervals, which referenced previous studies[3,7] and the Japanese Resuscitation Council guideline. A value of $P < 0.05$ was considered statistically significant. All statistical analyses were carried out with JMP Pro 14.0 for Windows (SAS Institute, Cary, NC, USA). This manuscript was written based on the STROBE statement to assess the reporting of cohort and cross-sectional studies.[8]

RESULTS

Participants

IN TOTAL, 59 training courses were held during the study period spanning September 2010 to November 2018. The number of individuals who participated in the training course was 760, of whom 126 participated in the training course, and were counted multiple times, resulting in a total participant count of 1,025. The participants received questionnaire survey every each courses and responses to the questionnaire survey were obtained from 1,015 of the 1,025 participants. To investigate the cumulative effect of repeat training, we used the data after the 14th course; participants' perceptions before the course was started were assessed after the 14th course. The obtained data from the participants were 446 after the first course, 121 of 126 after the second course, 58 of 60 after the third course, 27 of 28 after the fourth course, 20 after the fifth course, and 17 after the sixth course (Fig. 2). The characteristics of the participants are shown in Table 3. The median (interquartile range) ages of the participants attending

(A) CPR Training Box APPA-KUN®

(B) CPR skill reporting system APPA-KUN Pro®

Fig. 1. A, CPR Training Box APPA-KUN, the personal training manikin for cardiopulmonary resuscitation (CPR). B, CPR skill reporting system APPA-KUN Pro. This system automatically records for 1 min the number of chest compressions, interruption of chest compressions, and the depth of chest compressions.

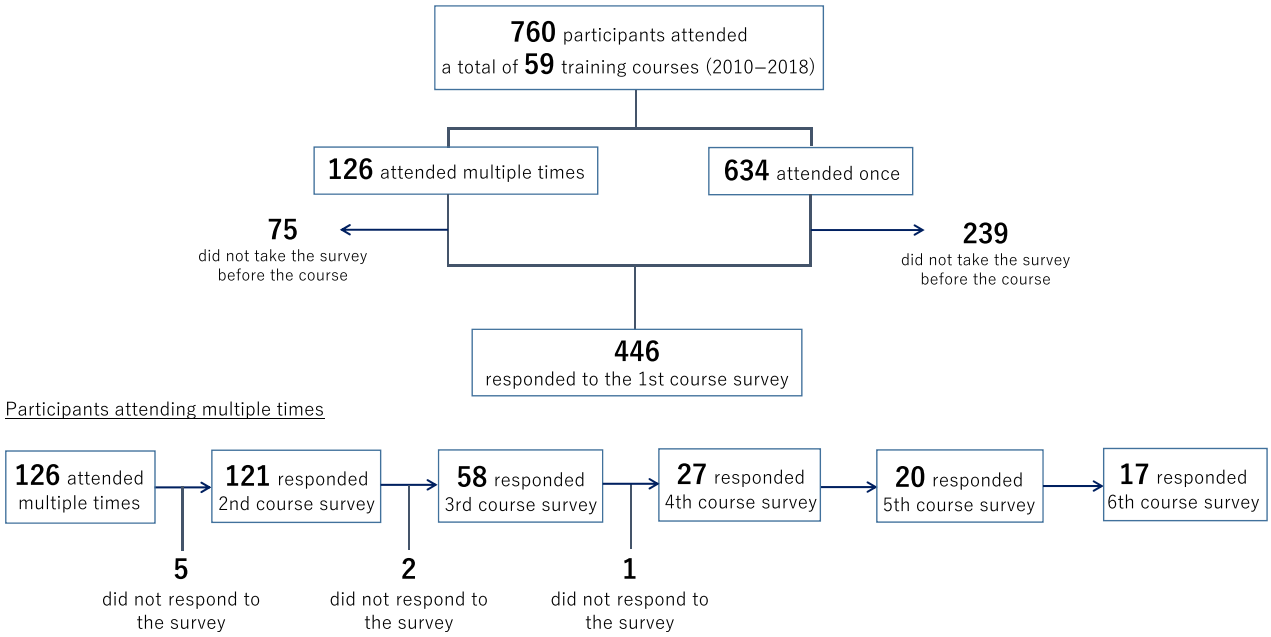

Fig. 2. Participant flow shows the number of participants (non-medical staff) who attended our simplified basic life support training course and the number of responses to the questionnaire surveys.

multiple times and once were 47 (34–56) years and 42 (31–50) years, respectively. Forty-four (34.9%) men and 82 (65.1%) women attended multiple times, whereas 159 (25.1%) men and 475 (74.9%) women attended only once. In terms of job categories, the staff of restaurants, cafeterias, and grocery stores occupied the majority of "others".

Changes in questionnaire survey response before and after the training course between the first and sixth attendance

The results regarding the number of positive responses toward the questionnaire survey before and after the training course are shown in Table 4. For "check for a response", the respective rates of positive responses before and after the training courses were 19.1% (84/439) and 80.9% (355/439) ($P < 0.001$) at the first training and 58.8% (10/17) and 94.1% (15/17) ($P = 0.005$) at the sixth training. For "chest compression," the respective rates of positive responses before and after the training courses were 9.8% (43/439) and 75.4% (331/439) ($P < 0.001$) at first training and 58.8% (10/17) and 88.2% (15/17) ($P = 0.008$) at the sixth training. For "use an AED", the respective rates of positive responses before and after the training courses were 21.9% (96/439) and 89.3% (392/439) ($P < 0.001$) at first training and 60% (12/20) and 80% (16/20) ($P = 0.045$) at the fifth training. However, there was no significant difference at the sixth training: 88.2% (15/17) and 94.1% (16/17) ($P = 0.317$) (Table 4).

Table 3. Characteristics of the participants in a simplified basic life support training program for non-medical staff working at a university hospital

	Participants attending multiple times (n = 126)	Participants attending once (n = 634)	P-value
Age (years), median (interquartile range)	47 (34–56)	42 (31–50)	0.0080
Sex, n (%)			
Male	44 (34.9)	159 (25.1)	
Female	82 (65.1)	475 (74.9)	0.0230
Job, n (%)			
Office work	13 (10.3)	275 (43.4)	
Assistant	1 (0.8)	49 (7.7)	
Cleaning staff	9 (7.1)	21 (3.3)	
Security guard	4 (3.2)	29 (4.6)	
Volunteer	0 (0.0)	6 (0.9)	
Others (e.g., restaurant/ cafeteria staff)	99 (78.6)	254 (40.1)	<0.0001

Table 4. Changes in attitude from before to after the simplified basic life support training course for non-medical staff working at a university hospital

Number of classes	Before *n*/*N* (%)	After *n*/*N* (%)	*P*-value
Q1. Can you check for a response?			
No. of classes			
1	88/446 (19.7)	366/446 (78.5)	<0.001
2	30/121 (24.8)	90/121 (74.4)	<0.001
3	28/58 (48.3)	45/58 (77.6)	<0.001
4	9/27 (33.3)	23/27 (85.2)	0.004
5	14/20 (70.0)	18/20 (90.0)	0.045
6	10/17 (58.8)	16/17 (94.1)	0.005
Q2. Can you perform chest compression?			
No. of classes			
1	49/446 (10.9)	337/446 (75.6)	<0.001
2	14/121 (11.6)	89/121 (73.6)	<0.001
3	16/58 (27.6)	41/58 (70.7)	<0.001
4	7/27 (25.9)	23/27 (85.2)	0.001
5	14/20 (70.0)	18/20 (90.0)	0.045
6	10/17 (58.8)	15/17 (88.2)	0.008
Q3. Can you use an AED?			
No. of classes			
1	98/446 (21.9)	398/446 (89.2)	<0.001
2	43/121 (35.5)	92/121 (76.0)	<0.001
3	26/58 (44.8)	47/58 (81.0)	<0.001
4	15/27 (55.6)	24/27 (88.9)	0.003
5	12/20 (60.0)	16/20 (80.0)	0.045
6	15/17 (88.2)	16/17 (94.1)	0.317

AED, automated external defibrillator; *n*, number of attendees giving a positive response; *N*, total number of attendees.

Cumulative effect of repeat training

We assessed the effectiveness of repeat training with a multivariable logistic regression analysis whose model included age, sex, and number of courses attended. The results of the association between positive responses to the questionnaire survey before the training course and various factors are shown in Table 5. The number of courses attended (AOR 1.50; 95% CI, 1.31–1.72) was associated with a positive response to "check for a response" before the training course, whereas the number of courses attended (AOR 1.62; 95% CI, 1.40–1.88) and male sex (AOR 1.86; 95% CI, 1.19–2.90) were associated with a positive response to "chest compression". Similarly, the number of courses attended (AOR 1.69; 95% CI, 1.46–1.96) and male sex (AOR 2.27; 95% CI, 1.57–3.27) were also associated with a positive response to "use an AED".

Table 5. Cumulative effect of repeat training in simplified basic life support for non-medical staff working at a university hospital

	AOR	95% CI	*P*-value
Check for a response (before the training course)			
Number of courses attended	1.50	1.31–1.72	<0.001
Age	0.99	0.97–1.01	0.280
Sex (male/female)	1.34	0.91–1.95	0.140
Chest compression (before the training course)			
Number of courses attended	1.62	1.40–1.88	<0.001
Age	1.01	0.99–1.03	0.200
Sex (male/female)	1.86	1.19–2.90	0.007
Use an AED (before the training course)			
Number of courses attended	1.69	1.46–1.96	<0.001
Age	0.99	0.98–1.00	0.090
Sex (male/female)	2.27	1.57–3.27	<0.001

AED, automated external defibrillator; AOR, adjusted odds ratio; CI, confidence interval.

Table 6. Differences in results, depending on the retraining interval, among non-medical staff working at a university hospital who completed repeat simplified basic life support training programs

Interval	Negative response (%)	Positive response (%)	*P*-value
1 year			
Check for a response			
<1 year (*n* = 72)	38 (52.8)	34 (47.2)	0.030
>1 year (*n* = 170)	113 (66.5)	57 (33.5)	
Chest compression			
<1 year (*n* = 72)	46 (63.9)	26 (36.1)	0.004
>1 year (*n* = 170)	139 (81.3)	31 (18.7)	
Use an AED			
<1 year (*n* = 72)	32 (44.4)	40 (55.6)	0.030
>1 year (*n* = 170)	100 (58.5)	70 (41.5)	
6 months			
Check for a response			
<6 months (*n* = 10)	5 (50.0)	5 (50.0)	0.310
>6 months (*n* = 232)	146 (62.9)	86 (37.1)	
Chest compression			
<6 months (*n* = 10)	6 (60.0)	4 (40.0)	0.190
>6 months (*n* = 232)	179 (76.8)	53 (23.2)	
Use an AED			
<6 months (*n* = 10)	4 (40.0)	60 (60.0)	0.270
>6 months (*n* = 232)	128 (54.9)	104 (45.1)	

AED, automated external defibrillator.

Table 7. Optimal retraining timing in basic life support

References	Training interval
JRC Guideline 2015[12]	Unknown. Less than 12–24 months
ERC Guideline for Resuscitation 2015[13]	Unknown. Frequent "low-dose" retraining can be beneficial
Ciurzynski *et al*. 2017[4]	Less than 6 months for nurses
Niles *et al*. 2017[15]	Less than 12 months for refresher for nurses
Resuscitation Education Science: A Scientific Statement from AHA, 2018[6]	Unknown
Anderson *et al*. 2019[3]	Once every month is better than training at 3, 6, and 12 months

AHA, American Heart Association; ERC, European Resuscitation Council; JRC, Japan Resuscitation Council.

Difference in positive responses depending on the retraining interval

The differences in the number of positive and negative responses depending on the retraining interval are shown in Table 6. The number of positive responses for "check for a response" was 34 (47.2%) for an interval of <1 year (n = 72) and 57 (33.5%) for that of >1 year (n = 170) (P = 0.03). The number of positive responses for "chest compression" was 26 (36.1%) for an interval of <1 year and 31 (18.7%) for that of >1 year (P = 0.004). The number of positive responses for "use an AED" was 40 (55.6%) for an interval of <1 year and 70 (41.5%) for that of >1 year (P = 0.03). There was no significant difference in the number of positive responses when comparing an interval of <6 months to that of >6 months.

DISCUSSION

WE SHOWED THE cumulative effect on the attitude of non-medical workers to BLS skills by taking the simplified BLS training multiple times. Our previous research reported that the quality of CPR improves before and immediately after attendance at a training course.[2] The results of these two studies show that repetitive BLS training not only helps maintain and improve the attitude and confidence of non-medical workers in their BLS skills but also might improve the quality of CPR administered. Currently, BLS training courses for non-medical personnel are widely held in various locations, such as schools, sports facilities, and driving schools, to improve the prognosis of patients with cardiopulmonary arrest. It is important for a whole society to acquire BLS techniques. From the results of this study, we clarified that repeating an annual CPR training course for non-medical workers improves their attitude toward performing CPR. It might also be useful to recommend this frequency of repeat training to the general public to improve the prognosis of people in cardiopulmonary arrest.

The confidence and attitude of non-medical workers toward BLS were significantly higher in the group undergoing BLS training at an interval of <1 year. The American Heart Association CPR guidelines set the expiration date of BLS providers at 2 years,[6] but there are reports that a 2-year training interval is too long for them to maintain their skills.[9–11] In addition, BLS is aimed at medical professionals, and there is little evidence that BLS training is applicable to non-medical people. There is not enough evidence in the guidelines of the Japan Resuscitation Council to recommend an optimal interval or method of retraining for non-medical people, and as CPR skills will decline before 12–24 months,[12] more frequent retraining is suggested. Other major resuscitation guidelines and other studies have also reported that there is not enough evidence for determining an optimal interval or method of retraining (Table 7).[4,13–16] In another study, randomized control trials reported that monthly CPR training was more effective than that at 3-, 6-, or 12-month intervals,[3] but practically, it is difficult for non-medical workers to attend a monthly training course. In our hospital, whether the participants attend the next training course and the interval between attendances are left up to them. Only 10 people attended retraining in <6 months, and there was no difference in the results compared with those who attended >6 months later. However, in the analysis examining the 1-year interval, the attitude scores of the 72 participants (30% of the total number of those participating multiple times) who took the training course within <1 year were significantly better than those of the other participants. We have recommended retraining for BLS using flyers and in the courses, but the percentage of participants attending BLS retraining in <1 year was only 30%. However, the number of positive responses toward BLS was good in those retaking the course in <1 year, and thus, it is reasonable to recommend that participants take the BLS course again within 1 year.

The number of male participants who answered "I can" for the CPR and AED questions was greater than that of the female participants in this study. We evaluate the quality of chest compression using the CPR skill report system APPA-KUN Pro (Alexon, Osaka, Japan) (Fig. 1). This CPR evaluation system automatically records for 1 min the number of chest compressions, interruption of chest compressions, and

the depth of chest compressions in our training course. The participants found that chest compression actually requires considerable power and that endurance is necessary to continue chest compression. Thus, male participants who are more confident in their physical strength than female participants might have a more positive attitude. One report noted that sufficient depth was not obtained in chest compressions delivered by female students, but it was improved by providing feedback,[17] which is similar to our findings. With regard to AEDs, it is speculated that there is a difference with men due to the potential awareness barrier to electronic devices, which is closely related to the lack of skills.[18]

There are some limitations in this study. First, our previous study[2] reported improvements in CPR quality before and immediately after attendance, but the present study is a questionnaire study, and a direct assessment of the cumulative effect and attendance interval on CPR quality was not carried out. Second, this study was undertaken in a single university hospital, and the details of the job types of the participants were not assessed. Third, the ceiling effect in the training course is unknown because the number of people who answered "I can" in the questionnaire before attendance increased smoothly up to the fifth training, but after the sixth training, it no longer increased and the number of participants was small. Further research is needed to clarify and resolve these limitations. Finally, as this study is an observational study, there may be unknown confounding factors.

CONCLUSIONS

REPEAT BLS TRAINING for non-medical staff correlated positively not only with a single educational effect but also with a cumulative effect gained from repetitive attendance. A course interval of <1 year from the previous attendance would be important for maintaining a positive attitude toward CPR and AED use.

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DISCLOSURE

Approval of the research protocol: This prospective observational study was approved by the Ethics Committee of Osaka University Graduate School of Medicine (No. 10119).
Informed consent: N/A.
Registry and the registration no. of the study/trial: N/A.
Animal studies: N/A.
Conflict of interest: None.

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