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

Hiroshi Matsuura,1 Tomohiko Sakai,1 Yusuke Katayama,1 Tetsuhisa Kitamura,2 Tomoya Hirose,1 Hisatake Matsumoto,1 Tsunehiro Matsubara,1 Taku Iwami,3 Yuji Fujino,4 and Takeshi Shimazu1

1Department of Traumatology and Acute Critical Medicine, 2Department of Social and Environmental Medicine, Division of Environmental Medicine and Population Sciences, Osaka University Graduate School of Medicine, Suita, 3Kyoto University Health Service, Kyoto, and 4Department of Anesthesiology and Intensive Care, Osaka University Graduate School of Medicine, Suita, Japan

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. Generally, most people who initially encounter a patient are of a non-medical population. Therefore,
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. A randomized control trial study reported that monthly training is more effective for the acquisition and retention of high-quality CPR skills. Other studies recommended retraining within 6 or 7 months, and American Heart Association course completion cards are valid for 2 years through the end of the month in which the card is issued. 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 basic life support training program for non-medical staff working at a university hospital. 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 basic life support training program for non-medical staff working at a university hospital.

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.
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% confidence 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\(^3\) 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

---

**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                      | DVD         | 6          |
| movie in-hospital                      |             |            |
| 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.

---

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.

© 2020 The Authors. *Acute Medicine & Surgery* published by John Wiley & Sons Australia, Ltd on behalf of Japanese Association for Acute Medicine
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 before and after the 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 | Participants attending once | 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 |

© 2020 The Authors. Acute Medicine & Surgery published by John Wiley & Sons Australia, Ltd on behalf of Japanese Association for Acute Medicine
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 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 (82.9)| <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 (88.8)| 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 (55.5)  | 24/27 (88.8)| 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.

### 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.
aturally after attendance at a training course. The results of the studies show that repeatability and quality of CPR improve before and immediately after attendance at a training course. The results of the studies show that repeatability and quality of CPR improve before and immediately after attendance at a training course. The results of the studies show that repeatability and quality of CPR improve before and immediately after attendance at a training course. The results of the studies show that repeatability and quality of CPR improve before and immediately after attendance at a training course.  

DISCUSSION  
We showed the cumulative effect of the attitude of non-medical workers toward BLS techniques 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. 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 to 2 years, but there are reports that a 2-year training interval is too long for them to maintain their skills. 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, 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 1). In another study, randomized control trials reported that monthly CPR training was more effective than that at 3-, 6-, or 12-month intervals, 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 is 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

| Table 7. Optimal retraining timing in basic life support |
|-----------------|-----------------|
| References      | Training interval |
| JRC Guideline 2015  | Unknown. Less than 12–24 months |
| ERC Guideline for Resuscitation 2015 | Unknown. Frequent “low-dose” retraining can be beneficial |
| Ciurzynski et al. 2017  | Less than 6 months for nurses |
| Niles et al. 2017   | Less than 12 months for refresher for nurses |
| Resuscitation Education Science: A Scientific Statement from AHA, 2018  | Unknown |
| Anderson et al. 2019 | 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.
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, 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.

There are some limitations in this study. First, our previous study 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 was 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

Effect of a repeat simplified 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.

ACKNOWLEDGEMENT

We thank our colleagues from Osaka University Center of Medical Data Science and Advanced Clinical Epidemiology Investigator’s Research Project for providing their insight and expertise to aid our research.

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.

Animal studies: N/A.

Conflict of interest: None.

REFERENCES

1. Kitamura T, Kiyohara K, Sakai T et al. Public-access defibrillation and out-of-hospital cardiac arrest in Japan. N. Engl. J. Med. 2016; 375: 1649–59.
2. Hirose T, Iwami T, Ogura H et al. Effectiveness of a simplified cardiopulmonary resuscitation training program for the non-medical staff of a university hospital. Scand. J. Trauma Resusc. Emerg. Med. 2014; 22: 31.
3. Anderson R, Sebaldt A, Lin Y, Cheng A. Optimal training frequency for acquisition and retention of high-quality CPR skills: a randomized trial. Resuscitation 2018; 135: 153–61.
4. Ciurzynski SM, Gottfried JA, Pietraszewski J, Zalewski M. Impact of training frequency on nurses’ pediatric resuscitation skills. J. Nurses Prof. Dev. 2017; 33: E1–7.
5. Woollard M, Whitfield R, Newcombe RG, Colquhoun M, Vetter N, Chamberlain D. Optimal refresher training intervals for AED and CPR skills: a randomised controlled trial. Resuscitation. 2006; 71: 237–47.
6. American Heart Association. Emergency Cardiovascular Care program Administration Manual Guidelines for Program Administration and Training International Version. 2018.
7. Son JW, Ryoo HW, Moon S et al. Association between public cardiopulmonary resuscitation education and the willingness to perform bystander cardiopulmonary resuscitation: a metropolitan citywide survey. Clin. Exp. Emerg. Med. 2017; 4: 80–7.
8. Vandenbroucke JP, von Elm E, Altman DG et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. Epidemiology 2007; 18: 805–35.
9. Hamilton R. Nurses’ knowledge and skill retention following cardiopulmonary resuscitation training: a review of the literature. J. Adv. Nurs. 2005; 51: 288–97.
10. Madden C. Undergraduate nursing students’ acquisition and retention of CPR knowledge and skills. Nurse Educ. Today 2006; 26: 218–27.
11. Meaney PA, Sutton RM, Tsima B et al. Training hospital providers in basic CPR skills in Botswana: acquisition, retention and impact of novel training techniques. Resuscitation. 2012; 83: 1484–90.
12. Okada K. The step toward 2015 JRC Guidelines since the end of the 2nd World War. Nihon Rinsho. Jpn. J. Clin. Med. 2016; 74: 337–44.
13. Hunyadi-Antičević S, Protić A, Patrk J et al. European resuscitation council guidelines for resuscitation 2015. Lijec. Vjesn. 2016; 138: 305–21.
14 Cheng A, Nadkarni VM, Mancini MB et al. Resuscitation education science: educational strategies to improve outcomes from cardiac arrest: a scientific statement from the American Heart Association. Circulation 2018; 138: e82–122.

15 Niles DE, Nishisaki A, Sutton RM et al. Improved retention of chest compression psychomotor skills with brief "Rolling Refresher" training. Simul. Healthc. 2017; 12(4): 213–9.

16 Neumar RW, Shuster M, Callaway CW et al. Part 1: Executive summary: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. Circulation 2015; 132(18 Suppl 2): S315–S367.

17 López-González Á, Sánchez-López M, Rovira-Gil E, González-García A, Ferrer-López V, Martínez-Vizcaíno V. Sex differences in the effort indicators during cardiopulmonary resuscitation manoeuvres on manikins. Eur. J. Emerg. Med. 2015; 22: 62–5.

18 Women Will: Closing Asia’s digital gender gap. Google Asia Pacific Blog 2014. [Cited 18 Dec 2019]. Available from: https://asia.googleblog.com/2014/10/women-will-closing-asias-digital-gender.html.