Canadian Medical Education Journal
Revue canadienne de l'éducation médicale

The timing of booster sessions may not improve resuscitation skill retention among healthcare providers: A randomized controlled trial
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Volume 14, Number 3, 2023

URI: https://id.erudit.org/iderudit/1106007ar
DOI: https://doi.org/10.36834/cmej.74401

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Publisher(s)

Canadian Medical Education Journal

ISSN

1923-1202 (digital)

Explore this journal

Cite this article

Waldolf, R., Dion, P.-M., Bould, D., Bould, C., Crnic, A., Etherington, C., McBride, G. & Boet, S. (2023). The timing of booster sessions may not improve resuscitation skill retention among healthcare providers: A randomized controlled trial. *Canadian Medical Education Journal / Revue canadienne de l'éducation médicale*, *14*(3), 99–106. https://doi.org/10.36834/cmej.74401

Article abstract

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Methods: After ethics approval, healthcare providers who completed an initial CPR training course were randomly assigned to either an early booster, late booster, or no booster group. Participants' mean resuscitation scores, time to initiate compressions, and time to successfully provide defibrillation were assessed immediately post-course and four months later using linear mixed models.

Results: Seventy-three healthcare professionals were included in the analysis. There were no significant differences by randomization in the immediate post-test (9.7, 9.2, 8.9) or retention test (10.2, 9.8, and 9.5) resuscitation scores. No significant effects were observed for time to compression. Post-test time to defibrillation (mean ± SE: 112.8 ± 3.0 sec) was significantly faster compared to retention (mean ± SE: 120.4 ± 2.7 sec) ($p = 0.04$); however, the effect did not vary by randomization.

Conclusion: No difference was observed in resuscitation skill retention between the early, late, and no booster groups. More research is needed to determine the aspects of a booster session beyond timing that contribute to skill retention.

Canadian Medical Education Journal

Brief Reports

The timing of booster sessions may not improve resuscitation skill retention among healthcare providers: a randomized controlled trial

Le délai avant une séance de rappel n'influencerait pas le maintien des compétences en réanimation acquises par les professionnels de la santé : un essai randomisé contrôlé

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Published ahead of issue: Mar 1, 2023; published Jun 27, 2023. CMEJ 2023, 14(3) Available at https://doi.org/10.36834/cmej.74401

Abstract

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Résumé

Introduction : Des séances de rappel peuvent favoriser le maintien des compétences en réanimation cardio-pulmonaire (RCP) chez les professionnels de la santé; toutefois, le moment optimal pour offrir ces séances est inconnu. Cette étude visait à explorer les différences dans le maintien des compétences en fonction du moment où intervient la séance de rappel.

Méthodes : Après avoir obtenu une approbation éthique, nous avons réparti au hasard des professionnels de la santé ayant suivi une formation initiale en RCP entre un groupe qui a reçu un rappel précoce, un groupe qui a eu un rappel tardif et un groupe qui n'a pas reçu de séance de rappel. Les scores moyens de réussite de la réanimation, le temps moyen pris avant de commencer les compressions et le temps moyen pris pour effectuer avec succès une défibrillation ont été évalués immédiatement après la séance et quatre mois plus tard, à l'aide de modèles mixtes linéaires.

Résultats : Les données de 73 professionnels de la santé ont été analysées. Il n'y a pas eu de différences significatives à la suite de la randomisation dans les scores de réanimation au post-test immédiat (9,7; 9,2; 8,9) et au test sur le maintien des compétences (10,2; 9,8 et 9,5). Aucun effet significatif n'a été observé en lien avec le délai avant d'entamer les compressions. Le délai de défibrillation était significativement plus court après la séance (moyenne ± SE : 112,8 ± 3,0 sec) que lors du test de maintien des compétences (moyenne ± SE : 120,4 ± 2,7 sec) (p=0,04); cependant, l'effet n'a pas été différent d'un groupe à un autre.

Conclusion : Aucune différence n'a été observée sur le plan du maintien des compétences en réanimation entre les groupes avec rappel précoce, avec rappel tardif et sans rappel. De plus amples travaux sont nécessaires pour déterminer les caractéristiques d'une séance de rappel, autres que le moment où elle intervient, qui contribueraient au maintien des compétences.

Introduction

Cardiac arrest is a major cause of mortality.[1–4] Prompt and effective cardiopulmonary resuscitation (CPR) following cardiac arrest has been shown to double the odds of survival.[5,6] Course participants are encouraged to renew their Basic Life Support (BLS) certification every year. However, studies show that CPR skills can deteriorate much sooner than this recommended timeframe, as early as three months.[2,7–11]

Refresher, or booster sessions, have been shown to effectively improve CPR skill retention,[12–15] in line with information processing theory.[16] According to information processing theory, when material is first perceived, it is temporarily stored in short-term memory. To successfully "learn" the material, it must move to long-term memory.[16] One of the key ways that information moves from our short-term memory to our long-term memory is through repetition.[16] However, the optimal timing for repetition remains unclear. While some studies found that a repetition soon after initial teaching was more effective, others found that delayed repetition was more effective for long-term skill retention.[18,19]

Though there has yet to be consensus as to the optimal timing of booster sessions for CPR skill retention among healthcare professionals, literature from other fields suggests this value may be 10-30% of the number of days between the initial training and retention test.[20] We aimed to determine the optimal timing of booster sessions for CPR skill retention after completion of a BLS course, with sessions offered at two different timepoints within this suggested interval (i.e., 10-30%).

Materials & methods

Ethical approval was obtained from the Montfort Hospital Research Ethics Board (#18-19-08-020). This paper is reported according to the CONSORT checklist.[21]

Design

We conducted a prospective randomized control trial.

Participants

Frontline healthcare providers across four hospitals in Ottawa, ON, Canada were included as long as they had not taken a BLS course in the previous six months.

Intervention

Booster sessions followed a standardized ten-minute format. The initial portion involved performing a two-minute resuscitation scenario in front of an experienced instructor who shares immediate feedback based on performance gaps. The scenario involved entering a room in the hospital and noticing a patient lying unconscious on the floor. A mannequin with feedback capabilities was used to provide participants with real-time feedback on their performance (e.g., compression depth, rate, and recoil).

Outcomes

The primary outcome was participants' mean score on a standardized Heart and Stroke Foundation resuscitation checklist (Appendix A), which has demonstrable face validity as it is used by CPR certification organizations (maximum score of 13 points).[22] High-quality compression (i.e., appropriate depth and speed) was indicated by the appearance of a green light on the mannequin. The participants needed 30 high quality compressions in the allotted 15 to 18 seconds to pass. The two secondary outcomes were the time to initiate compressions and the time to successfully provide a defibrillation. Participants were videotaped once immediately after their resuscitation scenario and again four months later during the retention test. The retention test used the same resuscitation scenario as the initial test. To account for potential scheduling difficulties, a window of five days before or after the desired date was considered acceptable.

Sample size

Assuming an alpha error of 0.05 and conservatively high correlation between repeated measures of 0.8, based on findings from a previous BLS study,[23] a total sample size of 54 subjects (i.e., 19 per group) would provide 80% power for finding a significant inter-group difference. Factoring in a 40% dropout rate before the retention test, we calculated 90 subjects at recruitment (i.e., 30 per group) would be the total sample size.

Randomization

Participants were randomly assigned to one of three groups using the randomize function in Microsoft Excel: early booster (three weeks post-course), late booster (eight weeks post-course), or no booster (control group).

Blinding

Outcomes were assessed by video raters with BLS expertise, who underwent initial standardization (intra-class correlation = 0.988). Video raters were blinded both to the participants' assigned groups as well as to whether a video was the immediate post-test or the retention test. Participants were made aware of their group assignment after completing the immediate post-test.

Statistical methods

Data were analyzed using linear mixed model repeated measures with SPSS 17.0 (SPSS Inc., Chicago, IL). The mean of the two raters' scores was considered the dependent variable, the test's timing was the within-subjects factor (immediate post-test or retention test), and the between-subjects factor was the group assignment (control, early booster, or late booster). A p-value of 0.05 was considered statistically significant.

Results

Eighty-six participants were randomized, of which 73 completed the study and were included in the analysis: 34 participants in the control group, 23 in the early booster group, and 16 in the late booster group (Appendix B). Demographic characteristics of participants are provided in Table 1. The inter-rater reliability between raters assessing participants' performance was 0.83.

Table 1. Demographic data.

	Control (*n* = 34)	Early Booster (*n* = 23)	Late Booster (*n* = 16)
Gender: *n* (%)			
Male	7 (20.6)	6 (26.1)	4 (25.0)
Female	27 (79.4)	17 (73.9)	12 (75.0)
Age: mean±SD	42.4±10.8	43.3±13.9	43.3±12.8
Primary language: n (%)			
English	119 (55.9)	15 (65.2)	8 (50.0)
Other	15 (44.1)	8 (34.8)	8 (50.0)
Education: n (%)			
PhD	12 (35.3)	6 (26.1)	7 (43.8)
Masters	11 (32.4)	10 (43.5)	7 (43.8)
Bachelor	4 (11.8)	1 (4.3)	1 (6.3)
College	4 (11.8)	4 (17.4)	1 (6.3)
High School	3 (8.8)	2 (8.7)	0 (0)
Occupation: n (%)			
Nurse	17 (50.0)	13 (56.5)	9 (56.3)
Respiratory therapist	2 (5.9)	3 (13.0)	1 (6.3)
Physician	9 (26.5)	5 (21.7)	4 (25.0)
Porter	0 (0.0)	1 (4.3)	0 (0.0)
Anesthesia assistant	6 (17.6)	1 (4.3)	2 (12.5)
Physiotherapist	0 (0.0)	0 (0.0)	0 (0.0)
Prior CPR training: n (%)			
Yes	32 (94.1)	23 (100.0)	16 (100.0)
No	2 (5.9)	0 (0)	0 (0)
BLS training > 6 months ago: *n* (%)			
Yes	34 (100.0)	23 (100.0)	16 (100.0)
No	0 (0)	0 (0)	0 (0)
No response	0 (0)	0 (0)	0 (0)

Primary outcome results

Immediate post-test scores were not statistically different among control, early booster, and late booster groups (9.7, 9.2, 8.9) (Figure 1). Retention test scores in the three groups were also not statistically different (10.2, 9.8, and 9.5). Combining all participants together, the mean retention test score (mean ± SE: 9.8 ± 0.2) was significantly higher than the immediate post-test score (mean ±SE: 9.3 ± 0.2) (mean difference: 0.6 ± 2.4; p=0.02). There was no effect of the groups on the mean score (i.e., the resulting increase in mean scores were consistent in all groups).

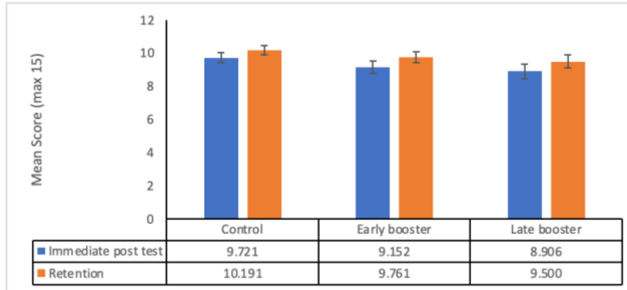

Figure 1. Mean score with standard errors between groups

Secondary outcome results

There was no significant effect of test (immediate post-test vs. retention) between groups nor interactions (tests X groups) for time to compression. There was no statistically significant difference in times when comparing the groups to each other.

For time to defibrillation, the immediate post-test score (mean ± SE: 112.8 ± 3.0 sec) was significantly lower compared to the retention score (mean ± SE: 120.4 ± 2.7 sec) (mean difference 7.6 ± 3.7; p=0.04). There was no effect of the groups (Control, Early and Late Booster) or interaction (tests X groups) on the defibrillation time. We also compared these outcomes by profession and found no significant effects.

When comparing mean scores by profession, we found lower immediate post-test scores among respiratory therapists (mean = 7.4) compared to the post-test and retention test scores of nurses (post-test mean = 9.8; retention mean=10.0) and physicians (post-test mean = 9.7; retention mean=9.9) ($p < 0.05$).

Discussion

Contrary to our hypothesis, we did not find any significant differences in scores across the three groups (early, late or control [i.e. no booster]). It remains unclear, as to what the optimal timing for BLS booster sessions may be given there was no difference in the performance between the early booster and late booster groups.

Our results contradict prior research showing that skills fade rapidly within the first three months after initial training.[10] This could be due to our small sample size.

Another potential reason is that five among the thirteen possible points on the scoring grid are directly related to using the Automated Emergency Defibrillator (AED). During the booster sessions, much of the feedback offered to participants pertained to the AED sequence. As such, those who had received feedback on these items during their booster may have been more likely to focus on these elements during the retention test. This raises the question as to whether it is the feedback received during a booster session that may be more impactful than the specific timing of the session. This is supported by a recent scoping review founding more evidence on the benefit of feedback for maintaining CPR skills, rather than on the timing of booster sessions.[24] Our study is aligned with information processing theory, showing that any practice repetition helps to move new materials to long-term memory.[16] Although our control group did not receive any booster, they were exposed to the immediate post-test so that we measured their immediate short-term learning. This immediate post-test may have acted as a repetition according to information processing theory. Future research should compare feedback vs. no feedback using various booster session timeframes. Professional experience may also be a factor to explore further as respiratory therapists appeared to score lower than nurses and physicians.

Strengths and limitations

One of the main strengths of this study is that it includes a variety of practising healthcare providers, rather than a single profession or experience level [15,2518,26] We also recruited healthcare professionals who were at least six months from their certification to avoid contamination of our retention data.

A limitation was that the immediate post-test may have reinforced retention through the testing effect, and that the same scenario was used at all time points. However, this method was the most rigorous to answer our research question and avoid additional uncontrolled variables related to using various scenarios. It should also be noted that it is resource-intensive to schedule booster sessions for each participant.

Conclusion

No difference was observed in resuscitation skill retention between the early, late, and no booster groups. More research is needed to determine the elements of a booster session beyond timing that helps to maintain skill retention.

Conflicts of Interest: The authors declare no conflicts of interest.
Funding: This project received a grant from the Association médicale universitaire de l'Hôpital Montfort (AMUHM)–Department of Family Medicine. Dr. Boet was supported by The Ottawa Hospital Anesthesia Alternate Funds Association and the Faculty of Medicine, University of Ottawa with a Tier 2 Clinical Research Chair.

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Appendix A. BLS scoring grid

Adult CPR and AED Skills Testing Checklist

Student Name____ Date of Test ____

In-Facility Scenario: "You are working in a hospital or clinic, and you see a person who has suddenly collapsed in the hallway. You check that the scene is safe and then approach the patient. Demonstrate what you would do next."

Prehospital Scenario: "You arrive on the scene for a suspected cardiac arrest. No bystander CPR has been provided. You approach the scene and ensure that it is safe. Demonstrate what you would do next."

Assessment and Activation

Checksresponsiveness
Shouts for help/Activates emergency response system/Sends for AED
Checks breathing
Checks pulse

Once student shouts for help, instructor says, "Here's the barrier device. I am going to get the AED."

Cycle 1 of CPR (30:2) ***CPR feedback devices preferred for accuracy*

Adult Compressions

Performs high-quality compressions*:

- Hand placement on lower half of sternum
- 30 compressions in no less than 15 and no more than 18 seconds
- Compresses at least 5 cm (2 inches)
- Complete recoil after each compression

Adult Breaths

Gives 2 breaths with a barrier device:

- Each breath given over 1 second
- Visible chest rise with each breath
- Resumes compressions in less than 10 seconds

Cycle 2 of CPR (repeats steps in Cycle 1) ***Only check box if step is successfully performed***

#Compressions # Breaths # Resumes compressions in less than 10 seconds

Rescuer 2 says, "Here is the AED. I'll take over compressions, and you use the AED."

AED (follows prompts of AED)

Powers on AED # Correctlyattachespads # Clearsforanalysis # Clearstosafelydeliverashock
Safelydeliversashock

Resumes Compressions

Ensures compressions are resumed immediately after shock delivery

- Student directs instructor to resume compressions *or*
- Student resumes compressions

STOP TEST

Instructor Notes		
• Place a ✓ in the box next to each step the student completes successfully. • If the student does not complete all steps successfully (as indicated by at least 1 blank check box), the student must receive remediation. Make a note here of which skills require remediation (refer to Instructor Manual for information about remediation).		
Test Results	Check **PASS** or **NR** to indicate pass or needs remediation:	**PASS** # **NR** #
Instructor Initials_Instructor HSF ID #_______Date ___		

Appendix B. CONSORT Flow Chart

Enrollment

Assessed

(n = 86)

Allocation

Randomized
(n = 86)

Allocated to early booster (n = 25)

(n = 23)

Allocated to late booster (n = 20)
Attended late booster session

session (n = 4)

Allocated to control (n = 41)
♦Received no booster (n = 41)

Follow-Up

Lost to follow-up: did not attend retention test (n = 2)

Lost to follow-up: did not attend retention test (n = 4)

Lost to follow-up: did not attend retention test (n = 7)

Analysis

Analysed
(n = 23)

Analysed
(n = 16)

Analysed
(n = 34)