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## Effectiveness of self-directed cardiopulmonary resuscitation learning in lay rescuers: infant basic life support study

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### Abstract

**Background:** Adequate training in infant basic life support (BLS) for parents and nursery school teachers is an important component of infants' safety training program at home and nursery school. There are several barriers to traditional in-classroom cardiopulmonary resuscitation (CPR) training programs include time, costs, and logistics. Self-directed CPR learning (SDL) kit was recently developed to overcome these barriers. This study evaluated the effectiveness of SDL kit in lay rescuers on infant BLS.

**Methods:** A total of 10 nursery school teachers were involved in this study. Performance of infant BLS was measured by the specialized manikin (Resusci Baby QCPR™ and SimPad™, Laerdal Medical Japan Co., Ltd). Infant BLS was performed pre-learning and post-learning respectively. Infant BLS learning was done for about 20 minutes by SDL kit (MiniBaby™, Laerdal Medical Japan Co., Ltd).

**Results:** Tendency of improvement of chest compression depth after self-directed learning of infant BLS was shown ( $p < 0.1$ ). There were several rescuers who were not able to achieve rescue breath (RB) before this learning process ( $n = 5$ ). There was a statistical significance in improvement of RB tidal volume in this subgroup after self-directed learning of infant BLS ( $p < 0.05$ ).

**Conclusion:** Although BLS for infants is still within this single Japanese Resuscitation Council-BLS algorithm, RB is more emphasized for infants. In this study, half of the rescuers could not perform RB at all before learning. Significant improvement of RB for this particular subgroup brought by this infant BLS SDL kit is very impressive efficacy.

**Key words:** Self-learning, Chest compression depth, Rescue breath, Psychomotor skill, Skill retention

### I. Introduction

There are about 2,000 cases of pediatric out-of-hospital cardiac arrests (OHCA) in all over Japan every

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year[1]. Almost half of them have been happening in infant age group, less than 1 year old. Infant OHCA usually occur at home or in nursery school. Thus, adequate training in infant basic life support (BLS) for parents and nursery school teachers is an important component of infants' safety training program at home and nursery school. Barriers to traditional in-classroom cardiopulmonary resuscitation (CPR) training programs include time away from home and work place to

complete training, learner discomfort over being in a classroom setting, and instructors who include information irrelevant to CPR, and logistics[2].

Self-directed CPR learning (SDL) kit for BLS was developed and it demonstrated equal learning outcomes comparable to those obtained with traditional instructor-led courses and is a more time efficient tool for CPR training including automated external defibrillator (AED). Furthermore, the SDL kit overcomes many of the barriers that keep individuals from learning CPR and appears to contribute to bystanders' confidently attempting CPR[2-5].

It was only for adult CPR previously, however, SDL kit for infant BLS was developed and translated into Japanese recently. This study evaluated the effectiveness of SDL kit in lay rescuers on infant BLS.

## II. Subjects and methods

A total of 10 nursery school teachers were involved in this study after informed consent. Performance of infant BLS was measured by the specialized manikin (Resusci Baby QCPR™ and SimPad™, Laerdal Medical Japan Co., Ltd). Infant BLS was performed for two minutes pre-learning and post-learning respectively. Infant BLS learning was done for about 20 minutes by SDL kit (MiniBaby™, Laerdal Medical Japan Co., Ltd).

Performance of infant BLS was measured and evaluated using several parameters, such as chest compression (CC) depth, adequate CC location, CC interruption, CC numbers (/session, /minute), rescue breath (RB) tidal volume (TV), RB numbers (/session, /minute), and total performance score. Data was analyzed comparing pre-learning and post-learning on CC depth and RBTv. P value less than 0.05 means statistical significance and less than 0.1 means tendency.

This study was approved by the ethics board of the Medical Research Committee of Tokyo Metropolitan Children's Medical Centre (TMCMC). Publication of the study was approved by the Institutional Review Board of TMCMC.

## III. Results

Total of 10 nursery school teachers performed infant BLS sessions pre and post-learning. Measured parameters were indicated in Table 1. Session length was 2 minutes and CC vs. RB ratio was 30:2. Targeted CC depth and RBTv were set at 40 mm and 100 ml respectively. Desired CC tempo per minute (numbers/min) was 100-120/min. More CC interruption (second) and less CC fraction (%) led less CC numbers/session. Desired RB numbers were 10/session and 5/minute.

There were no statistical significance in improvement of CC depth, RBTv and other parameters, however, tendency of improvement of CC depth after self-directed learning of infant BLS was shown in Figure 1 ( $p < 0.1$ ).

There were several rescuers who were not able to achieve RB before this learning process ( $n = 5$ , rescuer# 1-5). Statistical significance of improvement of RBTv in this subgroup after self-directed learning of infant BLS was shown in Figure 2 ( $p < 0.05$ ).

## IV. Discussion

In the guidelines of Japanese Resuscitation Council (JRC), BLS for adults and that for children are united and simplified into one algorithm basically[6]. Although BLS for infants is still within this single JRC-BLS algorithm, RB is more emphasized for infants because infant OHCA is often caused by respiratory pathophysiology[7].

SDL kit gave us paradigm shift in BLS training. It made the training time period shorter, increased manikin vs. learner ratio and gained actual practice time per learner using manikin, saving costs and human resources for education, produced possibility to multiply learners at home and gave chance to repeat training, and importantly, kept equal learning outcomes comparable to those obtained with traditional instructor-led courses.

During the BLS training, RB part is more difficult to improve comparing to CC. It is more obvious in infant BLS training, though RB is more important in infant BLS. Previous studies showing SDL kit efficacy used adult manikin and were not particularly indicating

Table 1 Infant BLS performance pre and post-learning Lines shaded in yellow indicates subgroup who could not do RB pre-learning (rescuer# 1-5)

	Rescuer #	Total Score	Chest Compression (CC)					Rescue Breath (RB)			
			CC Interruption		Adequate CC Location	CC numbers	CC depth	CC numbers	RB numbers	RB Tidal Volume	RB numbers
			sec	%	%	/session	mm	/min	/session	ml	/min
PRE	1	55	11	62	93	136	39	108	0	0	0
	2	51	12	62	80	133	39	107	0	0	0
	3	37	9	63	99	152	32	119	0	0	0
	4	2	13	58	15	120	36	102	0	0	0
	5	8	8	67	25	162	41	120	0	0	0
	6	76	8	62	100	151	39	117	6	57	3
	7	69	9	62	97	151	38	119	7	103	3
	8	57	13	57	100	137	39	118	7	108	3
	9	71	7	67	99	147	40	111	4	135	2
	10	48	11	55	96	121	41	110	6	146	3
	Ave. ± SD	47 ± 25	10 ± 2	62 ± 4	80 ± 32	141 ± 14	38 ± 3	113 ± 6	3 ± 3	55 ± 62	1 ± 2
POST	1	54	8	65	55	152	39	116	8	69	4
	2	60	11	65	91	150	40	115	0	0	0
	3	66	10	60	92	147	39	120	8	94	4
	4	27	14	54	98	120	41	109	0	0	0
	5	14	13	56	41	128	42	114	2	125	1
	6	22	11	53	100	116	39	108	1	25	0
	7	60	11	63	100	145	41	113	0	0	0
	8	43	13	57	100	128	40	112	2	77	1
	9	70	8	67	67	153	38	112	10	58	5
	10	50	10	57	95	129	41	112	6	77	3
	Ave. ± SD	47 ± 18	11 ± 2	60 ± 5	84 ± 20	137 ± 13	40 ± 1	113 ± 3	4 ± 4	53 ± 42	2 ± 2
p	NS	NS	NS	NS	NS	0.1	NS	NS	NS	NS	

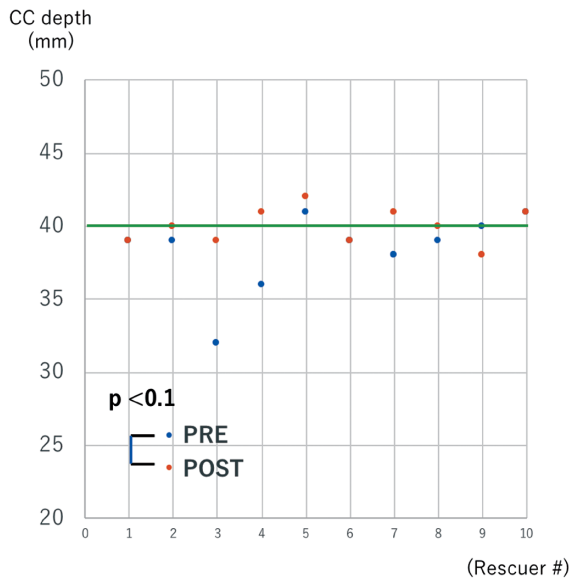


Fig. 1 Improvement of chest compression depth (target depth was set at 40 mm: green line)

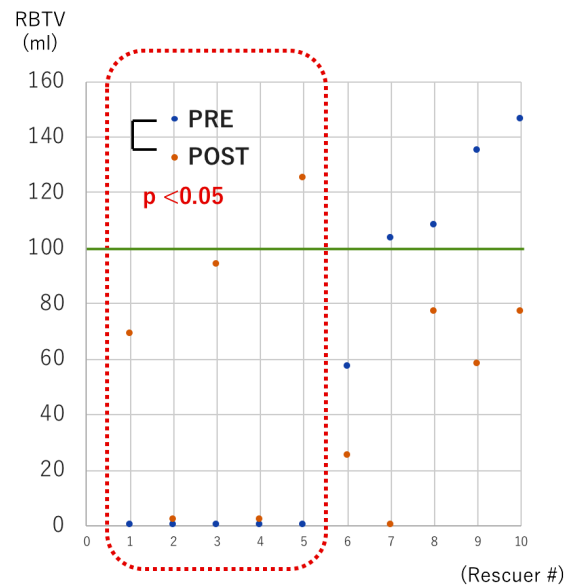


Fig. 2 Improvement of rescue breath (target volume was set at 100 ml: green line) Red circle indicates subgroup who could not do RB pre-learning (rescuer# 1-5)

the specific efficacy of RB skill improvement in infant BLS [2-5]. In this study, half of the rescuers could not perform RB at all before learning. Significant improvement of RB for this particular subgroup brought by this infant BLS SDL kit is thought to be very impressive efficacy.

This study has several limitations, such as low number of materials, only for lay rescuers, no information of skill retention, no information of previous experience of BLS training or practice, etc. Efficacy of this SDL kit for infant BLS using bag valve mask ventilation performance by health care providers, such as nurses and residents, should be investigated further. Skill retention is another important parameter need to be studied. Additionally, new CPR feedback application is recently investigated (iCPR) [8]. The combination of SDL kit learning and practice with iCPR feedback would be another target of research in near future.

### Contributors

NS conceived and designed the study, collected, analyzed, and interpreted the data. NS, TI, MN, and KO were involved in writing and reviewing the manuscript.

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### Conflict of interest

The authors declare that they have no conflicts of interest, either financial or non-financial, with the context of this article, except for the public grant from Tokyo Metropolitan.

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