




Basic Life Support Guidance for Caregivers of NICU Graduates: Evaluation of Skill Transfer after Training

Aswathy Benedict¹ Femitha Pournami¹  Ajai Kumar Prithvi¹ Anand Nandakumar¹
Jyothi Prabhakar¹ Naveen Jain¹

¹Department of Neonatology, Kerala Institute of Medical Sciences, Trivandrum, Kerala, India

Address for correspondence Femitha Pournami, DM, Department of Neonatology, Kerala Institute of Medical Sciences, Trivandrum 695029, Kerala, India (e-mail: femi_shifas@yahoo.com).

J Child Sci 2022;12:e119–e124.

Abstract

Background Intensivists indeed discharge neonatal intensive care unit (NICU) graduates after a period of physiological stability. There is, however, a real risk of life-threatening events at home. Survival after such episodes depends on time from arrest to initiation of basic life support (BLS). It is rational to train parents who would be first responders. We sought to measure objectively and prospectively, effect of BLS training on parents of NICU graduates on the psychomotor, cognitive, and affective domains of human learning.

Methods After face-to-face training sessions, proportion of home caregivers who obtained 100% marks on a pretested performance checklist for psychomotor skills of BLS on a mannequin were measured. Two other domains of learning and number of attempts required to obtain desirable results were also analyzed.

Results Median (interquartile range [IQR]) birth weight of the high-risk neonates was 1,050 g (930, 1570) and median gestational age was 29 (IQR 28, 33) weeks. More than 75% of parents had no prior exposure to BLS training. Among 46 trained caregivers, 80.4% achieved the desired score of 5 in the psychomotor performance checklist on the first attempt. A maximum of two attempts was required to reeducate and achieve score of 5 in the remaining caregivers. Forty-two (91.3%) caregivers obtained full marks on cognitive domain test. All caregivers responded positively toward affective domain questionnaire.

Conclusion It is possible to train parents in BLS measures and demonstrate their psychomotor skills on a mannequin effectively. No parents who were approached refused training or indicated anxiety in learning the skills required.

Keywords

- ▶ basic life support
- ▶ preterm
- ▶ out of hospital arrests
- ▶ domains of learning

Introduction

“Out of hospital” medical emergencies are unanticipated. Basic life support (BLS) is the first level of medical care given for a life-threatening event, till focused medical care is at hand. India and other low-middle income countries are yet to reach an ideal state of paramedical emergency response

services similar to the “911” or “999” systems. Hence, first responders are most often laymen. Correct administration of this critical support allows time for medically trained responders to arrive and commence advanced care. BLS awareness and education is being given to people from various sections of society so that the pool of trained potential first responders can be expanded.¹

received
December 27, 2021
accepted after revision
July 5, 2022

DOI <https://doi.org/10.1055/s-0042-1757147>.
ISSN 2474-5871.

© 2022. The Author(s).

This is an open access article published by Thieme under the terms of the Creative Commons Attribution License, permitting unrestricted use, distribution, and reproduction so long as the original work is properly cited. (<https://creativecommons.org/licenses/by/4.0/>)
Georg Thieme Verlag KG, Rüdigerstraße 14, 70469 Stuttgart, Germany

One of the most vulnerable groups is infants discharged after long and advanced intensive care support, even if they have achieved a reasonable period of physiological stability. Infant survival after sudden life-threatening event is known to be largely dependent on the time from arrest to initiation of effective resuscitation.² Timely resuscitation has greatly improved neurological outcome as well.³ Some units do train caregivers of neonatal intensive care unit (NICU) graduates in BLS methods, though it is yet to become part of uniform and standard discharge planning.⁴ It becomes imperative that the first responder (parent at home) are aware and confident of BLS.^{5,6}

Our unit already administers BLS training to parents of NICU graduates who are considered at reasonable risk of developing life-threatening events postdischarge (on a case-to-case basis). No equipment except the physical presence of the first responder is required for our method of administering BLS. During these sessions, we try to address all three domains of human learning. The psychomotor domain includes utilization and coordination of learned motor skills. The cognitive domain aims to address the acquisition of relevant knowledge. The affective domain deals with the feelings or attitudes of the learner.⁷ We believe that all three are exiguously relevant to BLS training.

Nonetheless, whatever be the method used for teaching, critical assessment that measures the effectiveness of skills and knowledge transfer would aid improvement. In this prospective observational study, we sought to measure objectively, the effect of this training on the three domains of human learning: psychomotor, cognitive, and affective after the session.

Methods

This prospective observational study was conducted between February 2021 and July 2021 in our Level IIIB (National Neonatology Forum of India accredited) NICU in South Kerala. We implement early parent participation and unrestricted visitation, albeit with strict adherence to hospital and government COVID-19 protocols.⁸ The unit follows a well-known indigenously designed checklist format for high-risk newborn care commencing in the perinatal period itself (Blue book).⁹⁻¹¹ Families are prepared for the necessity for BLS training during counseling sessions close to rooming-in. We included parents of neonates (planned for discharge) satisfying any one of the following criteria: (1) birth at gestational age < 32 weeks, (2) neonatal encephalopathy warranting specific therapy, (3) congenital airway anomaly confirmed by video laryngoscopy, and (4) brief, resolved, unexplained event requiring admission and NICU monitoring. Only those parents who do not wish to have their details recorded were excluded.

Based on prior experience, and considering the high levels of literacy and health-seeking behavior noted in Kerala, most parents were expected to perform well after the facilitator's demonstrations.¹² Assuming that 80% of the parents/caregivers would achieve the desired score (5 out of 5 check marks) on psychomotor performance checklist (primary

outcome), the study sample size of 25 was planned for estimating the expected proportion with 10% margin of error and 95% confidence level.

A consultant and senior resident with adequate fluency in the common languages used (English, Malayalam, Tamil, Hindi) were the main facilitators who conducted training session in a standardized format. BLS steps were according to the modified Neonatal Resuscitation Protocol and American Heart Association (AHA) guidelines with no additional equipment requirement.^{13,14} The sessions usually lasted for 1 hour. Parents and grandparents were invited, with the intention of training at least two caregivers. Key areas of "must-know" medical information were imparted. This was followed by hands-on session on a neonatal mannequin (Laerdal). The techniques of assisted breaths and chest compressions were corrected during the hands-on session and practice was allowed until confidence in the technique was achieved. The number of attempts required to reach this level was recorded.

Postsession tests to evaluate the three domains were started after the caregivers expressed satisfaction of their understanding; and confidence of techniques. Each caregiver was evaluated separately, immediately after the program. The psychomotor component of learning was tested by recording the skill competency on a modification of a standard BLS checklist (►Fig. 1). The questionnaire to analyze their cognitive and affective domain about BLS was administered at the end of the session.

Effectiveness of skill transfer was measured as a proportion of home caregivers who obtained 100% marks on the performance checklist for psychomotor skills of BLS, after their training session, as part of discharge readiness program. Knowledge transfer was measured as proportion of home caregivers/parents who obtained > 80% marks on the objective test administered after the BLS training to measure cognitive domain of learning. The affective domain of BLS training was measured as proportion of home caregivers/parents who responded positively on the questionnaire. Association of relevant demographic factors (educational level below 12th grade, previous BLS training) with need for more than one attempt to obtain desired scores were also analyzed.

Data in MS Excel was analyzed using the STATA software version 16. Outcomes were represented as proportions, associations of relevant demographic factors with need for repeated attempts to obtain desired scores were measured using Fisher's exact test.

Approval for the conduct of the study was obtained from the Institute Scientific committee and Human Ethics committee. Informed consent was obtained from parents for recording information for the purpose of the study.

Results

Forty-six caregivers from 25 families were included in the study. No caregiver refused to participate in the study (►Fig. 2). Relevant characteristics of the infants and caregivers included are described in ►Table 1.

OBSERVATION CHECK LIST	
(I) Psychomotor domain: (Primary outcome)	
Key components are in BOLD Format	
Indication for BLS – Unresponsive and not breathing	
A. Shouts for help; Stimulation by flicking soles OR rubbing back; places baby on firm surface in correct position (neck extension by appropriate maneuver)	[]
B. Checks breathing (look, listen and feel)	[]
C. "Mouth" to "mouth and nose" artificial Breaths . 2 breaths	[]
D. Effective (chest rise) . Checks by looking for chest rise	[]
E. Chest compression . Site (placement of thumbs encircling chest just below nipple line and centre of chest)	[]
. 30 compressions with call out	[]
. Allows recoil	[]
. Depth atleast 1.5 inch	[]
F. Resume cycle 2:30 (breath: chest compression)	[]
Marks ___/ 5	

Fig. 1 Checklist used to test psychomotor domain after training session. Items in bold format were considered key components for evaluation.

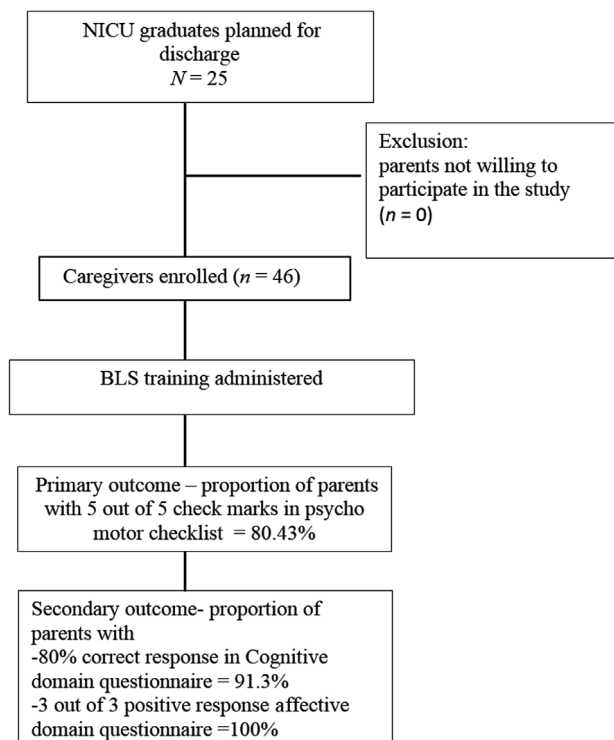


Fig. 2 Study flow diagram.

During the formal testing, all the caregivers who received BLS training scored 5 out of 5 in the psychomotor domain checklist (– **Table 2**). It is noteworthy that 80.4% ($n = 37$) of them could perform effective BLS on a mannequin after the first attempt. The trainer had to repeat specific sections, mainly (1) emphasizing need to call for help, (2) obtaining chest rise with assisted breathing, and (3) depth of chest compression; for nine (19.5%) of the caregivers.

Among those nine caregivers who required a second attempt, seven were mothers (25%), two were fathers (9.5%), three were non-Keralites, and one had previous exposure with BLS. More than 90% caregivers scored > 80% marks in the questionnaire administered to test the cognitive domain of learning. All responded positively to the questions asked to assess affective domain (constituted by awareness of the possibility of an emergency arising out of hospital, no increase in anxiety due to the training per se, and increased confidence in handling such situations correctly).

We attempted to study the association between educational status below 12th grade, exposure to previous BLS Training, and the need for more than one attempt to achieve the desired score in the psychomotor domain. No significant association was obtained between these factors and success with one attempt (relative risk [RR] 3 [95% confidence interval [CI] 0.91–9.86] and RR 0.45 [95% CI 0.06–3.18], respectively).

Table 1 Baseline characteristics of infants and caregivers

Serial no.	Characteristic	Measure
	Infant details (N = 25)	
1	Gestational age (wk) ^a	29 (28, 33)
2	Birth weight (g) ^a	1,050 (930, 1,570)
3	Male gender, n (%)	12 (47.8)
4	Indication for BLS training ^b , n (%)	
	- Very preterm	22 (91.3)
	- Encephalopathy	2 (6.5)
	- Critical congenital heart disease	6 (26.08)
	- Congenital anomalies	3 (8.6)
	Caregiver details (N = 46)	
5	Relationship with the baby, n (%)	
	- Mother	25 (54.3)
	- Father	19 (41.3)
	- Grandmother	2 (4.3)
6	Place of residence, n (%)	
	- Kerala	41 (89.13)
7	Highest educational qualification, n (%)	
	- Health professional (doctor, paramedical)	7 (15.21)
	- Post graduation	16 (34.7)
	- Under graduation	19 (41.3)
	- 12th grade	4 (8.7)
	- 10th grade	0
8	Received previous BLS training, n (%)	10 (21.73)
9	Nulliparous	14 (56)
10	History of previous infant death, n (%)	7 (15.2)

Abbreviations: BLS, basic life support; IQR, interquartile range.

^aMedian (IQR).

^bSome infants had > 1 indication for parental BLS training.

Table 2 Skill transfer measurements in domains of human learning (N = 46)

Domain	Achieved desired score in first attempt, n (%)
Psychomotor	37 (80.4)
Cognitive	42 (91.3)
Affective	46 (100)

Discussion

We objectively demonstrated that all caregivers who were trained were capable of performing correctly on the psychomotor checklist.

While scientific literature dealing with infant cardiopulmonary resuscitation (CPR) covers many facets, further developments are needed, particularly in parental attitudes and knowledge.^{4,15} Many units already practice some form of infant CPR education as part of their discharge planning

protocol. Methods used may vary, including video-based classes, group seminars, or carry-home materials. Real-time CPR instructions via phone has led to some improved rates of survival with good neurological outcomes but immediate commencement of CPR is preferable in both adults and children.¹⁶ Infant CPR Kit was designed by AHA and American Academy of Pediatrics, which mainly comprised instruction manuals, a digital video disc, and mannequin.³ Pierick et al showed that self-instructional tools are a reliable method of CPR training.³ Parents tended to review the kits to refresh their skills. E-learning platforms with pillow mannequin and demonstrating BLS was identified as a low-cost intervention within developed and developing countries to train mothers for healthy and safety of their infants.¹⁷

We conducted “instructor to trainee” independent sessions with each family. Compliance to training of busy parents in many settings may not be ensured by methods that depend on their using “take-home” material. We believe that face-to-face sessions with hands-on practice will help assure learning.

Timeframe of training are varied, some units teach parents prior to discharge, some during follow-up. We conducted the sessions a few days before discharge from hospital setting.

Assessments of practical skill transfer and feedback are not always part of protocols followed.^{17,18} There is a dearth of information on systematic evaluation of training methods. Applying results from drastically different backgrounds may not be appropriate for some families and their infants. Effectiveness of methods used need to be addressed in specific settings. Moreover, we tested three domains of human learning—psychomotor, cognitive, and affective. This was done using a pretested structured questionnaire and an observation checklist (→Fig. 2).

In this study we had 10 caregivers, who had received previous BLS training, out of which only one required another attempt to fulfill psychomotor observation checklist. Association with better performance of the previously trained caregivers was not statistically significant. The numbers are small and these associations need to be tested in larger studies. In contrast, authors from Tasmania and Cu et al reported better results in those who had previous training.^{4,19} There were more mothers among those who attended the training sessions; similar to other reports.³ Other authors have mentioned more respondents who had achieved postgraduate education, not unlike our own finding.²⁰

In this study, all those trained scored > 80% in the questionnaire to assess knowledge (cognitive domain) consisting of 10 multiple-choice questions. Other authors have demonstrated as low as 29% of them satisfying criteria on cognitive domain.⁴ This may be because our questions were not esoteric. It was made simple and only the “must know” facts were tested. One must emphasize that the literacy and health-seeking behavior in Kerala is known to be appreciable.¹²

In our setting, all caregivers responded affirmatively to the three questions asked to assess improving confidence and decreasing anxiety with training. It was observed that some parents feel reassured by receiving CPR training because it provides them with concrete skills to use in an emergency.²¹ Parsons and Mackinnon determined that teaching parents infant CPR would not impact parents' psychosocial burden negatively.²⁰

Our study has some significant strengths. Dedicated face-to-face sessions with each family ensured attendance. Practical demonstration of skills by caretakers was supervised and approved by the investigator before concluding the meeting. No equipment is required for the application of the BLS method taught. A pretested succinct questionnaire/checklist was used in the study which evaluated all three domains of learning, that is, psychomotor (performance skills), cognitive (knowledge), and affective (attitude). Our study seems to be one of its kind.

On the downside, we did not study retention of skills and these are known to decline with time.²² Assessments done few days later may better reflect knowledge retention. A study by Dracup et al showed that 27.5% of parents were

unable to demonstrate satisfactory infant CPR skills immediately after a conventional instructor-led class.¹⁸ A related study of a subgroup of these subjects showed that after 6 months, only 33% of those trained were still able to demonstrate adequate CPR skill. Retention of skills tends to be poor. CPR skills begin to deteriorate within 3 to 6 months.²²

Our methods and findings may not be outright generalizable to all settings and other demographic factors.⁶ Multi-center large-scale prospective studies are required for establishing the effectiveness, acceptability, and retention of skills. Our “one-to-one” method of teaching could potentially add to the workload of doctors in the neonatal units which is often very busy and can be challenging in an Indian setup. Yet, we suggest utilizing the services of trained paramedical staff/nurse practitioners to conduct group sessions in high load units to circumvent these issues.

Conclusion

It is possible to train families of NICU graduates in infant BLS, including those with no medical education backgrounds. The caregivers were able to demonstrate their skills effectively on a mannequin. They attained good scores when essential knowledge was tested; families felt more confident and less anxious about their abilities to respond to emergencies that can occur out of hospital.

Future prospective studies are required for assessing the retention of skills and survival outcomes if a neonatal cardiac arrest occurs outside of a hospital.

Conflict of Interest

None declared.

References

- 1 Dake R. evaluation of basic life support training and skills in healthcare and nonhealthcare providers. *Int J Sci Stud* 2020;8 (01):67-71
- 2 Eisenberg M, Bergner L, Hallstrom A. Epidemiology of cardiac arrest and resuscitation in children. *Ann Emerg Med* 1983;12(11): 672-674
- 3 Pierick TA, Van Waning N, Patel SS, Atkins DL. Self-instructional CPR training for parents of high risk infants. *Resuscitation* 2012; 83(09):1140-1144
- 4 Stephens N. Perceptions of parental awareness, knowledge and anxiety levels regarding Infant Cardiopulmonary Resuscitation training amongst parents residing in SouthernTasmania. Accessed July 21, 2022 at: <https://researchonline.nd.edu.au/cgi/viewcontent.cgi?article=1260&context=theses>
- 5 Gelberg J, Strömsöe A, Hollenberg J, et al. Improving survival and neurologic function for younger age groups after out-of-hospital cardiac arrest in Sweden: a 20-year comparison. *Pediatr Crit Care Med* 2015;16(08):750-757
- 6 Stiffler D, Cullen D, Stephenson E, Luna G, Hartman TD. When baby stops breathing: analysis of mothers' interviews. *Clin Nurs Res* 2016;25(03):310-324
- 7 Ramalingam M. Assessment of learning domains to improve student's learning in higher education. *J Young Pharm* 2014;6 (01):27-33
- 8 Pillai A, Pournami F, Prabhakar J, Nair P, Jain N. Effect of early parent participation program on physiological stability in

- preterm infants: a randomized controlled trial. *Am J Perinatol* 2021;•••: Epub ahead of print. Doi: 10.1055/s-0041-1726126
- 9 Sujatha R, Jain N. Prediction of neurodevelopmental outcome of preterm babies using risk stratification score. *Indian J Pediatr* 2016;83(07):640–644
 - 10 Venkata SKRG, Pournami F, Prabhakar J, Nandakumar A, Jain N. Disability prediction by early Hammersmith neonatal neurological examination: a diagnostic study. *J Child Neurol* 2020;35(11):731–736
 - 11 Upadhyay S, Pournami F, Nandakumar A, Prabhakar J, Nair PMC, Jain N. Outcome of very preterm infants with early optimal nutrition strategy: a comparative cohort study. *Nutr Clin Pract* 2020;35(04):708–714
 - 12 Jana A, Basu R. Examining the changing health care seeking behavior in the era of health sector reforms in India: evidences from the National Sample Surveys 2004 & 2014. *Glob Health Res Policy* 2017;2(01):6
 - 13 Textbook of Neonatal Resuscitation (NRP) 7th Ed | AAP eBooks [Internet]. [cited August 5, 2021]. Accessed July 21, 2022 at: <https://ebooks.aappublications.org/content/textbook-of-neonatal-resuscitation-nrp-7th-ed>
 - 14 Craig-Brangan KJ, Day MP. Update: 2017/2018 AHA BLS, ACLS, and PALS guidelines. *Nursing* 2019;49(02):46–49
 - 15 Chia PCY, Lian WB. Parental knowledge, attitudes and perceptions regarding infant basic life support. *Singapore Med J* 2014;55(03):137–145
 - 16 Goto Y, Maeda T, Goto Y. Impact of dispatcher-assisted bystander cardiopulmonary resuscitation on neurological outcomes in children with out-of-hospital cardiac arrests: a prospective, nationwide, population-based cohort study. *J Am Heart Assoc* 2014;3(03):e000499
 - 17 Barry M. An evaluation of expectant parents knowledge, satisfaction and use of a self-instructional infant CPR kit. *Midwifery* 2015;31(08):805–810
 - 18 Dracup K, Moser DK, Doering LV, Guzy PM. Comparison of cardiopulmonary resuscitation training methods for parents of infants at high risk for cardiopulmonary arrest. *Ann Emerg Med* 1998;32(02):170–177
 - 19 Cu J, Phan P, O'Leary FM. Knowledge and attitude towards paediatric cardiopulmonary resuscitation among the carers of patients attending the Emergency Department of the Children's Hospital at Westmead. *Emerg Med Australas* 2009;21(05):401–406
 - 20 Parsons S, MacKinnon RJ. Teaching parents infant resuscitation. *Infant* 2009;5(03):77–80
 - 21 Rephaeli R, Gafanovich D, Shchors I, Weiser G. Can parental simulation improve neonatal CPR performance? A pilot study. *Eur J Pediatr* 2021;180(10):3247–3250
 - 22 Dracup K, Doering LV, Moser DK, Evangelista L. Retention and use of cardiopulmonary resuscitation skills in parents of infants at risk for cardiopulmonary arrest. *Pediatr Nurs* 1998;24(03):219–225, quiz 226–227