ORIGINAL ARTICLE

Evaluation of resident perception and knowledge following an interdisciplinary flipped class on neonatal resuscitation: An observational study

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Abstract

Background: Neonatal mortality in India is a major healthcare concern. Common causes include prematurity, birth asphyxia, and infections. National programs focus on new-born care and resuscitation. In teaching hospitals, paediatric and anaesthesia residents are first responders. Traditional learning methods are inadequate; interactive, scenario-based interdisciplinary training improves competence and teamwork in critical neonatal situations. *Aim and Objectives:* To evaluate resident perception regarding a flipped classroom teaching method and to document their change in skills. *Material and Methods:* A prospective observational study on neonatal resuscitation training was conducted at a medical college. Twenty-four anaesthesia and paediatric residents participated in a blended learning program, including pre-class materials and a three-hour face-to-face simulation session. The study used pre-tests, post-tests, and surveys to evaluate knowledge, skills, and satisfaction. A follow-up was conducted after six months. Medical Education Research Study Quality Instrument (MERSQI) tool was used to design our research. *Results:* The study achieved a MERSQI score of 14 out of 18, reflecting strong methodological quality in medical education research. All participants engaged with the preparatory materials, with every participant viewing the assigned videos. The simulation session was well-received, with high satisfaction rates. Pre-test, post-test, and 6-month follow-up scores showed significant improvement (p = 0.001). After 6 months, most participants felt confident in applying their knowledge. Seven residents encountered cases requiring intervention, all babies had good outcomes. Survey questionnaire showed good reliability (Cronbach's alpha 0.87). *Conclusion:* The flipped classroom method for neonatal resuscitation improved skills and knowledge retention, with benefits lasting six months. Participants reported high satisfaction and increased confidence in real-world scenarios.

Keywords: flipped class, neonatal resuscitation, skills training

Introduction

Neonatal mortality rate in India is around 20 for every 1,000 live births with disparities between states, and urban and rural regions [1]. Major causes of neonatal deaths include prematurity, birth asphyxia, infections, and congenital anomalies [2]. Nationwide programs focusing on basic new-born care and resuscitation like Navjaat Shishu Suraksha Karyakram and Helping Babies Breathe (HBB) programs were designed to help healthcare providers recognize babies who are not breathing at birth and provide timely interventions like stimulation, suctioning, and bag-and-mask ventilation [3,4]. Effective neonatal resuscitation requires knowledge of resuscitation algorithm and technical competence in performing these sequential tasks with continuous re-evaluation of the clinical status and responses to the interventions.

An estimated 10% of neonates require help to begin breathing, 5% require Positive Pressure Ventilation (PPV), 2% require intubation, 0.1% require cardiac compressions and 0.05% require adrenaline [5].

The traditional methods of learning neonatal resuscitation such as seminars and lectures fail to provide the hands-on, scenario-based training necessary for effective decision-making under pressure. A shift towards more interactive and engaging educational strategies is the blended method of teaching learning. This pedagogical model inverts the traditional learning environment by delivering instructional content outside of the classroom, often through pre-recorded lectures or reading materials, while using in-class time for practical application, problem-solving, and discussion [6]. The interdisciplinary nature of neonatal care necessitates a collaborative approach to training. Paediatric and anaesthesia postgraduates, who often work together in critical neonatal situations, require integrated educational experiences that reflect the realities of clinical practice. Interdisciplinary training has proved to foster improved communication, teamwork, and a holistic understanding of neonatal resuscitation from multiple perspectives [7]. A few studies among postgraduate training in medicine including a flipped classroom method on interdisciplinary training with hands on simulation experience [8]. Hence, we hypothesized that a blended learning approach combining flipped classroom methodology and hands-on simulation training will significantly improve the knowledge, skills, and competence of residents in neonatal resuscitation. The study aimed to train anaesthesia and paediatric residents to effectively identify and manage neonatal resuscitation, assess their views on the flipped classroom teaching method and document changes in their knowledge and skills after the hands-on training session.

Material and Methods

The study was performed according to Helsinki Declaration. Institutional ethical clearance was obtained to conduct the study (FMIEC/CCM/162/2020). All participants gave written informed consent for the study. We used Medical Education Research Study Quality Instrument (MERSQI) tool to design our research [9]. The tool includes six criteria which are – study design, sampling, and type of data, validity of evaluation instrument, data analysis and outcomes. Each criterion is allotted a score and a final total score is calculated.

This was a prospective and observational study done at a medical college with functioning simulation and skills centre. It included a single group of participants with a pre-test and post-test analysis. The sample consisted of 24 anaesthesia and paediatric residents who provided consent to participate, representing a 70% response rate from the overall student group. Pre-class activity included sharing of teaching material and standard online videos on neonatal resuscitation which was sent to all students via Google classroom which was our learner management system two weeks before scheduled class. The reading materials and the videos were checked for accuracy by paediatric faculty. The reading material included two documents – The American Heart Association Part 7 and Part 13 on neonatal resuscitation which are of 38 pages and 18 pages, respectively [10, 11].

The videos posted included - three YouTube videos prepared by aclscertification.com – i) Overview of neonatal resuscitation (seven minutes) ii) Neonatal resuscitation progam initial steps (12 minutes) iii) Neonatal resuscitation progam chest compression and ventilation (nine minutes). The 24 students were divided into two batches of 12 each. Each batch came for a three-hour face to face session conducted in Simulation and Skills lab, which included a pre-test consis-

ting of a mix of short essay question and multiple choice questions, in the form of quiz of 20 marks where we used Socrative Teacher and Socrative Student as our online technology. Facilitators performed one demonstration of neonatal resuscitation. The 12 learners were divided into 4 learners per group of 3 groups and were given a case scenario, in the team of 4, one was assigned as the leader, two assistant performers and one observer who recorded the sequence of the events. The equipment made available included - 3 towels, infant radiant warmer, thermometer, wraps, cap, shoulder roll, suction catheter – 8, 10 F, suction bulb, self-inflation bag, mask sizes – 00,0,1, LMA – 1, ETT – 2.5, 3, 3.5 ID, Miller blade – 0,1, paediatric stethoscope, pulse oximeter probe, 3 lead electrocardiogram monitor. We used the infant manikin with umbilical cord attached which could generate a pulse, allowed suctioning, mask ventilation and intubation. The pulse oximetry value was verbalized when asked for. The performance of the participants was monitored using a checklist prepared by the facilitators and checked for content validity by paediatrician and certified simulation instructors. Each case was followed by a de-briefing session, and peer feedback was encouraged. The facilitators used the Gather Analyse and Summarise (GAS) structure for de-briefing. All developed case scenarios were subject to face and content validation. At the end of the session the class topic was summarized and key take home messages were emphasized. All students were then give the post-test on Socrative student portal and residents filled up the anonymous session evaluation survey questionnaire consisting of 18 questions to be answered in Likert format and two open ended questions on Google form. The survey captured responses related to utilization of pre reading material, preparedness, participation, effectiveness, satisfaction, pre-test and facilitator role. After six months period the participants were given the test again and an anonymous survey questionnaire to document the usefulness of the blended learning program. For all the cases – residents had to perform all the steps of neonatal resuscitation as the cases were sequentially progressing to cardiac arrest, the performance checklist to be marked by the facilitator.

Statistical analysis

Descriptive analysis was done by frequency and proportion for categorical variables. The pre-test and post-tests were analysed using paired student t test. The reliability of the questions in the survey was analysed using Cronbach's alpha. The Statistical Package for the Social Sciences (IBM SPSS) software for Windows was used for analysis of data.

Results

The MERSQI score for our methodology was 14 out of 18, details are as shown in Table 1. Twenty-four residents completed all the activities of the flipped learning session. Ten residents were from paediatrics and 14 residents from anaesthesia. The group included seven men and seventeen women. Four participants were in their first year of residency, twelve in the second year, and eight in the third year. The mean age of all residents was 24 ± 2.1 years. The frequency of responses of the 24 students for the survey questionnaire is as shown in Table 2. The mean scores of 24 students for the pre-test, immediate post-test and 6 months later tests for 20 marks is as shown in table 4. Mean pre-test score of the 24 students was 7.29 ± 1.92. Mean post session post test score of the 24 students was 16.04 ±

1.65. Mean 6 months later post test score of the 24 students was 14.79 ± 2.57. There was statistical significance between pre-test and immediate posttest ($p = 0.001$), pre-test and 6 months post-test ($p = 0.001$) and between immediate posttest and 6 months posttest ($p = 0.004$). The six-month follow up questionnaire is as shown in Table 3. Out of the 7 students who had to participate in neonatal resuscitation requiring more than simple stimulation methods, 5 were from pediatrics and 2 from anesthesia, with 6 of the neonates requiring positive pressure ventilation to initiate breathing and circulation, and one neonate requiring chest compressions and a dose of adrenaline for resuscitation. All the 7 babies were discharged home successfully. The validity and reliability of the questions in the survey was done before data analysis. Construct reliability was determined using Cronbach's alpha. The coefficient reliability for the questionnaire was 0.87 which implied good reliability.

Discussion

In our study we used the MERSQI tool as our framework to identify the research methodology and guide in designing the research. This tool has been used by medical education researchers in

Table 1: Details of MERSQI tool score for our study

Domain	MERSQI item	Score
Study Design	Single group – pre-test, post-test	1.5
Sampling	Single institute Response rate (50-74%)	0.5 1
Type of Data	Objective measurement	3
Validity of evaluation instrument	Content Relationship to other variables	1 1
Data analysis	Data analysis appropriate for study design and type of data Beyond descriptive analysis	1 2
Outcomes	Satisfaction Knowledge and skills Behaviour Patient and healthcare outcome	3
Total Score - 18		Our score = 14

MERSQI - Medical Education Research Study Quality Instrument

Table 2: Distribution and responses regarding participation, utilization and facilitator's role

1. Utilization and perception of assigned pre session reading	Did not read or watch	Partly read/ watched	Read/ watched once	More than once	
a) Read the posted material		12 (50%)	12 (50%)		
b) Watched the posted video			24 (100%)		
c) The difficulty level of the reading material	Very difficult	Difficult	Easy	Very easy	
		12 (50%)	12 (50%)		
2. Understand the purpose and study objectives	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
				15 (62%)	9 (38%)
3. Actively participated in the class activity				15 (62%)	9 (38%)
4. Tried to make up understand				15 (62%)	9 (38%)
5. No problem in understanding				18 (75%)	6 (25%)
6. I am confident to make use of what I learned				18 (75%)	6 (25%)
7. I prefer this format to traditional didactic lecture				18 (75%)	6 (25%)
8. I am satisfied with today's class				15 (62%)	9 (38%)

Continued...

9. The concept of pre-test motivated me				18 (75%)	6 (25%)
10. Prepared for the pre-test			6 (25%)	12 (50%)	6 (25%)
11. Pre-test was helpful				17 (71%)	7 (39%)
12. I did not cheat in the test				15 (62%)	9 (38%)
13. The test was difficult			3 (12%)	15 (63%)	6 (25%)
14. Facilitators explanation was helpful				15 (62%)	9 (38%)
15. Facilitators encouraged active group discussions				15 (62%)	9 (38%)
16. Facilitators helped summarize and wrap-up the session				15 (62%)	9 (38%)
What was good about this session	Hands on session, preparation in the form of pre reading material, simulation session helped me put things into practical aspects, using case scenarios for progression made me feel realistic, following the guidelines in a systematic way, interdisciplinary learning.				
What could be improved	More case scenarios, all students to be given chance to become the team leader, more time to read the materials				

PG – postgraduates; SD – standard deviation

Table 3: Distribution and responses after six months follow up

Question	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Confident to assess for requirement of neonatal resuscitation			7 (29%)	15 (63%)	2 (8%)
Apply the knowledge and skill of the flipped learning on neonatal resuscitation				17 (71%)	7 (39%)
Use the systematic approach of neonatal resuscitation guidelines				15 (63%)	9 (47%)
Always co-ordinate and collaborate effectively with co-residents from other specialty in issues of patient care			8 (33%)	16 (67%)	
Have you encountered any cases in the last 6 months in neonates requiring more than simple stimulation to initiate breathing?	Yes		No		
	7 (39%)		17 (71%)		

Obstetrics and Gynaecology, and Internal Medicine to focus on quality in experimental, quasi experimental and observational designs [12]. The tool has been tested for usefulness and validity and scoring of literature [9, 13]. Reed applied the MERSQI tool on 210 educational research articles in 13 peer reviewed journals and found a mean total score of 9.95 and a range between 5 to 16. Our study scored 14 on the scale which is a good score in terms of quality and methodology [9].

The pre class preparation included students reading the posted material and watching the videos however only 50% of the students had read the posted material and 100% had watched the videos. Similar finding of students coming unprepared for flipped class was observed by researchers [14, 15]. Majority of the students had watched the three videos which lasted from seven minutes to 12 minutes in duration. Jamie also found that many students prefer videos over text as pre-reading materials [14]. It was found that keeping the video duration between 3 to 17 minutes increases success in implementation of flipped classes [16].

Student perception and satisfaction regarding the face-to-face session – higher percentage of students agreed or strongly agreed that the objectives of the flipped classroom where practicable. The interactive hands on simulation based learning enabled them to actively participate and they stated that they were more confident in using the knowledge and skills learnt. Similar findings were noted by few researchers who found that simulation based hands on activity improved the confidence of students to participate in real world situations [15, 17, 18]. Overall majority of the students were satisfied with the conduct of the training and preferred flipped classroom method over the didactic method. Many researchers found identical evidence in their research [15, 19, 20].

Results about student assessment in the form of pre and post tests using quizzes showed remarkable improvement after the face-to-face session with debriefing. Flipped classroom method incorporating hands on activity with facilitator led debriefing and quiz to assess the learning serves as motivator for students and a vital factor affecting the learning performance of students [21, 22]. Almost identical improvement of student performance was noted by few investigators [15, 17, 18, 23]. The use of case scenarios and simulation modalities was appreciated by students and they expressed desire to have more case scenarios and everyone to be given chance to be a team leader, however this was not feasible in terms of time constraints. Investigators have expressed the same thought in their review [19, 20]. Student retention of knowledge from baseline to after 6 months was persisting, however there was significant change between the immediate post session and the 6 months' score. This implies that there was attrition of knowledge to some extent. The need for frequent practice and longer instructions was suggested by rule ARL [24]. However, the findings of Nickerson reported 15% increase in knowledge contradicting our finding. This could be because the methodology used in their study included an in-situ simulation involving shoulder dystocia and neonatal resuscitation. All students self-evaluated their confidence in managing neonatal resuscitation after six months to be high. Seven students were involved in active resuscitation of new-borns in the six months and all babies had good outcomes which implies that the flipped classroom method does have an impact on patient care. Students were slowly accepting the concept of teamwork and collaborative practice as also observed by Cassandra Johnson [25].

There were a few studies which did not favour flipped classroom method over conventional training in literature [26, 27]. The reasons could be because the instructional designs were not complementing the blended learning methods or the learners were not motivated to adapt new methods and their methodology did not incorporate teamwork and leadership in neonatal resuscitation.

The relatively small sample size may limit the generalizability of our findings to broader populations. While our participants provided valuable insights, they were recruited from a single institution, which may not fully represent the diverse perspectives and experiences found across different organizational contexts. Future research would benefit from expanding the participant pool to include individuals from multiple departments and institutions to enhance the external validity of the results.

The flipped classroom method improved knowledge retention and practical skills, with sustained benefits observed after six months. Participants showed high satisfaction with the interactive, hands-on learning experience and reported increa-

sed confidence in managing real-world neonatal resuscitation scenarios. The integration of pre-class materials, simulation-based training, and debriefing sessions for neonatal resuscitation proved to be a successful pedagogical model.

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