



Nurses' Opinions on the Barriers to Effective Implementation of Developmental Care in Neonatal Intensive Care Units

Zahra Godarzi¹, Omolbani Rahimi^{1,*}, Nasrin Khalesi², Farin Soleimani³, Nooredin Mohammadi⁴ and Ahmad Reza Shamshiri⁵

¹Nursing and Midwifery Faculty, Tehran University of Medical Sciences, Tehran, Iran

²School of Medicine, Iran University of Medical Sciences, Tehran, Iran

³Pediatric Neurorehabilitation Research Center, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran

⁴Department of Critical Care Nursing, Nursing and Midwifery Faculty, Iran University of Medical Sciences, Tehran, Iran

⁵Dentistry Research Institute, Tehran University of Medical Sciences, Tehran, Iran

*Corresponding author: Nursing and Midwifery Faculty, Tehran University of Medical Sciences, Tehran, Iran. Tel: +98-9199363616, Email: o-rahimi@razi.tums.ac.ir

Received 2017 December 08; Revised 2018 August 10; Accepted 2018 August 15.

Abstract

Background: The implementation of developmental care in neonatal intensive care unit (NICU) saves neonates' energy and stabilizes their physiology, reduces stress in them and their family, and decreases hospitalization time and healthcare costs. The role of a neonatal nurse is crucial for an appropriate and successful execution of developmental care in NICU. This study was conducted to evaluate nurses' opinions on barriers to effective implementation of developmental care in NICUs of Tehran University of Medical Sciences.

Methods: This was a cross-sectional study carried out on a total of 138 nurses who had a minimum work experience of six months in NICUs. Data collecting tool was a 12-point questionnaire including questions related to 5 core measures of developmental care according to Coughlin's framework as well as questions associated with barriers based on a study by Wu. Descriptive and analytical statistics were used for data analysis.

Results: The mean age for 138 nurses was 31.76 ± 5.41 years (23 - 49 years). The mean work history in the NICU was 4.36 ± 3.58 years. Of all nurses, 79.7% were found to be familiar with developmental care practice. Among participants, 56.4% mentioned most part of their familiarity with developmental care; nurses mostly gained familiarity with developmental care via information exchange with nurse colleagues. The majority of participants described that inadequate time, inappropriate work environment in terms of space and equipment of NICU, and too many requests by parents were major barriers to deliver 5 core measures of developmental care in NICUs.

Conclusions: The implementation of developmental care was hampered by serious barriers.

Keywords: Barriers, Developmental Care, Neonatal Intensive Care Unit (NICU)

1. Background

Premature neonates admitted to the neonatal intensive care unit (NICU) are subject to many stressful factors such as painful medical interventions, sleep disturbance, high noise level, high level of light exposure, and continuous manipulations, which all occur because of infants' need for nursing and therapeutic interventions as well as separation from parents (1, 2). At present, changes in perception for improving the NICU environment have led to establishing most appropriate environments for promoting efficacy of medical treatment and neurodevelopmental growth of premature infants while both NICU staff and family are coming to closer contact (3). Advances in technology, pharmacology, and in particular, practice of hospi-

tal care for infants have caused opportunities not only to keep premature infants alive, but also let them grow (4). Despite these developments, there are still concerns over the influence of NICU on both term babies presenting a medical complication and premature infants (5), as premature infants are continuously under such stresses that are not consistent with their biological needs for the development of growing nervous system (1). Moreover, the presence of NICU strong lighting, high noise level, busy environment due to frequent visits by family, and activities of healthcare team expose infants to unpleasant stimuli (6).

The cause of sleep disturbance in neonates is due to a high level of noise and light, which influences the brain blood flow (7). In addition, long-term hospitalization

and need for implementation of invasive life-saving medical care expose premature neonates to stressful cycles of painful therapeutic interventions; leading to appearance of conditions, which are different from protected conditions provided by the womb for fetus development (8). Other stressors of the NICU environment, such as presence of painful invasive interventions (tracheal intubation, repeated cycles of needlestick injury associated with blood-taking and drug injection, and medical manipulations) may affect the normal growth of an infant's brain (9). A growing number of reports have provided evidence that more than 50% of medical manipulations or bombardment of painful stimulations is due to nursing interventions (10). Many efforts have been made to decrease undesirable effects of the NICU environment on neonates. Numerous studies have been carried out to improve quality of care in the NICU following the introduction of developmental care philosophy in 1980s (11).

Developmental care is provided by neonatal nurses to help reduce the effect of external stressful stimuli such as sound and light control as well as placing an infant in a secure tucked position similar to position in womb for ideal growth and development (12). In other words, developmental care is a caregiving platform consisting of all types of caregiving methods as well as dealing with social and physical aspects of an infant's need in NICU (13). In the light of these interventions, an infant's energy for continuous growth is maintained and eventually leads to physiological stability and easy recovery in mature and premature neonates (14). In addition, developmental care can improve an infant's growth cycle and promote the mental and social health of both newborns and family while it is cost-effective when benefits and outcomes are compared (12). At present, implementation of neonatal developmental care in advanced countries is a matter of scientific competition, which is considered as a routine practice with progressive expansion. However, American Joint Commission for healthcare improvement has stated five main aspects for evaluation of developmental care in NICUs according to evidence based on universe developmental care (UDC) model regardless of disease type: 1) developmental activities of daily living: positioning, feeding and skin care, 2) protected sleep, 3) healing environment (measurement and maintenance of recommended levels of sound and light, effective group collaboration, and delivery of evidence-based care, 4) family-centered care, and 5) pain and stress assessment and management (15).

Despite focus on importance of developmental care and extensive research over effect of developmental care on neonates within recent decade, provision of such care has not been simply possible in all medical settings. In addition, there is little knowledge on application of develop-

mental care in the NICU, worldwide (16).

The need for execution of developmental care in neonatal intensive care units and perception of nurses over barriers to deliver such care is considered as important indicators for assessment and could identify essential changes for supporting a healing environment. The present study was aimed to investigate nurses' opinions on the importance of barriers to effective implementation of developmental care in neonatal intensive care units of several educating hospitals in Tehran (Iran).

2. Methods

This was a cross-sectional study performed on 172 nurses who were selected by census method, had a minimum job experience of 6 months, and worked in nine NICUs in several teaching hospitals affiliated to Tehran University of Medical Sciences in 2012 - 2013. Data collecting tool was a questionnaire on barriers to provision of different measures of developmental care, which were answered by participants working in NICUs in a self-reporting manner.

After having distributed questionnaires, ensuring confidentiality of information and gaining nurses' satisfaction, 138 nurses returned their questionnaire. They were given about one week to answer the questions so that they can fill the questionnaire out at an appropriate time; working conditions and job pressure have minimal effects on the answers. Filling out the self-report questionnaire took at most 30 minutes.

Data collecting tool was a questionnaire composed of two sections; (a) a section for demographic characteristics including age, level of academic education in the field of nursing, work experience in nursing, work experience in NICU, employment status, history of familiarity with developmental care, method used to acquire the highest level of familiarity with developmental care, attending in workshops, and teaching courses on different subjects, and (b) questions on the barriers to provision of different measures of developmental care, which were answered by participants working in NICUs in a self-reporting manner. Considering similarity of objectives, the 12 items on barriers were adopted from the study by Wu C.L. who kindly provided the authors with written permission (17). These 12 items associated with barriers were 1) absence of sufficient time, 2) lack of experience on infant care, 3) lack of knowledge over the effect of developmental care on newborn, 4) lack of skill, 5) lack of guideline, 6) absence of effective team working, 7) lack of active communication with parents, 8) NICU inappropriate space for delivery of care, 9) inappropriate NICU environment in terms of essential equipment for delivery of care, 10) delivery of routine

care, 11) high cost of developmental care (changes in NICU structure and equipment,...), and 12) repeated requests by parents and lack of their cooperation in delivery of care. These 12 items, adopted from the study by Coughlin, were used to determine the level of barriers to implementation of standard core measures of developmental care including developmental activities of daily living (feeding, skin care, and positioning), protected sleep, healing environment (measurement and maintenance of recommended levels of sound and light, effective group collaboration, and delivery of evidence-based care), family-centered care, and pain and stress assessment and management (15). The range for evaluation of barriers in the questionnaire was scored from 0 (absence of barrier) to 4 (highest level of barrier). Eventually, scores obtained for each barrier were added up and mean was calculated in form of percentage and expressed in three formats as follows: 1) absence or presence of mild barrier, 2) presence of intermediate barrier, and 3) presence of serious or extremely serious barriers. The content and construct validity of the assessment tool as well as reliability of the questionnaire was examined by 22 nurses through repeated test at two occasions with an interval of 10 days. The minimum and maximum agreement percentage for items present in the questionnaire were 54.55% and 100%, respectively. These values were taken into account while collecting data for the present research.

After obtaining the approval of Ethics Committee of Tehran University of Medical Sciences, the researcher presented her introduction letter to hospitals of Tehran University of Medical Sciences and explained the objectives of the study to the related authorities in the hospitals. Then, NICU nurses were told that they could participate in the study if they were willing to. They were also informed that they could withdraw from the study anytime during the study without any effect on their work in the NICU. After sampling, informed consent was obtained from the nurses. The questionnaires were coded for each nurse without mentioning the nurse's name. The data of 138 questionnaires were analyzed in SPSS version 20 using descriptive statistics and Mann-Whitney statistical test. The P value ≤ 0.05 was considered as significant.

3. Results

The participants' response was 80%. The mean age calculated for 138 nurses was 31.76 ± 5.41 years (23 - 49 years). The mean work history in the NICU is 4.36 ± 3.58 years (Table 1). Of all nurses, 79.7% were found to be familiar with developmental care practice. Among the participants, 56.4% mentioned most part of their familiarity was with developmental care; nurses mostly gained familiarity with de-

velopmental care via information exchange with nurse colleagues (Table 2).

Table 1. The Frequency Distribution of Individual and Job Characteristics of Nurses in the NICUs of Educational Hospitals in Tehran University of Medical Sciences

Characteristics	Values
Age (y)	31.76 \pm 5.41
Sex	
Female, No. (%)	137 (99.3%)
Male, No. (%)	1 (0.7%)
Level of education	
BA, No. (%)	128 (92.8%)
MA, No. (%)	10 (7.2%)
Nursing experience (y)	7.17 \pm 4.84
Nursing experience in NICU (y)	4.36 \pm 3.58
Background of familiarity with developmental care	
Yes, No. (%)	110 (79.7%)
No, No. (%)	28 (20.3%)

Table 2. The Frequency Distribution of the Method of Familiarity with Developmental Care Among Nurses Working in the NICUs of Educational Hospitals in Tehran University of Medical Sciences

Method of Familiarity with Developmental Care	Frequency	Percentage
Information exchange with nurse colleagues	62	56.4%
NICU nursing short-term training courses	60	54.5%
Self-study	57	51.82%
Training workshops	55	50%
Attending nursing conferences inside the unit or hospital	47	42.7%
Information exchange with physician colleagues	37	33.6%
Attending congresses	19	17.3%
Documented national program	2	1.8%

With respect to our data, perception of 138 nurses of the present study, over 5 core measures of developmental care, is presented in the following parts. The most important barriers to delivery of activities of daily living including feeding and nutrition, skin care, and posture as well as mobility, were lack of adequate time (86, 62.32%), inappropriate NICU environment in terms of enough space for delivery of care (76, 55.07%), inappropriate environment (necessary equipment) (74, 53.62%), repeated requests by parents and lack of their cooperation in the process of routine care practice (69, 50%), all given a score equal to 4, and indicating presence of serious or extremely serious barriers (Table 3).

Table 3. Frequency of Barriers to Provision of Developmental Care in NICUs of Teaching Hospitals in Tehran According to the Nurses' Perception^a

Barriers	Core Measures of Developmental Care				
	Activities of Daily Living ^b	Protected Sleep	Healing Environment	Family-Centered Care	Pain and Stress Assessment and Management
Lack of sufficient time	86 (62.32%)	101 (73.19%)	88 (63.77%)	100 (72.46%)	88 (63.77%)
Inappropriate environment (available space)	76 (55.07%)	93 (67.39%)	88 (63.77%)	81 (58.7%)	75 (54.35%)
Inappropriate environment (necessary equipment)	74 (53.62%)	79 (57.25%)	93 (67.39%)	75 (54.35%)	76 (55.07%)
Repeated requests by parents and lack of cooperation	69 (50%)	76 (55.07%)	65 (47.1%)	71 (51.45%)	78 (56.52%)
Routine care practice	69 (50%)	74 (53.62%)	67 (48.55%)	68 (49.28%)	74 (53.62%)
High cost (structure & equipment changes)	60 (43.48%)	70 (50.72%)	77 (55.8%)	66 (47.83%)	68 (49.28%)
Lack of professional awareness	65 (47.1%)	75 (54.35%)	70 (50.72%)	75 (54.35%)	61 (44.20%)
Lack of activity guideline	61 (44.2%)	68 (49.28%)	72 (52.17%)	63 (45.65%)	62 (44.93%)
Lack of efficient team working	61 (44.2%)	67 (48.55%)	65 (47.1%)	61 (44.2%)	62 (44.93%)
Lack of work experience	56 (40.58%)	60 (43.48%)	62 (44.93%)	50 (36.23%)	64 (46.38%)
Lack of effective communication with parents	55 (39.86%)	56 (40.58%)	51 (36.96%)	54 (39.13%)	59 (42.75%)
Lack of skill	57 (41.3%)	58 (42.03%)	61 (44.2%)	64 (46.38%)	53 (38.41%)

^a Only the barriers described as serious or extremely serious are presented.

^b Feeding, skin care, sleep positioning.

Regarding the most important barriers for implementation of protected sleep care was associated with lack of adequate time (101, 73.19%), whereas inappropriate NICU environment in terms of available space (93, 67.39%), inappropriate environment (necessary equipment) (79, 57.25%), repeated requests by parents, and lack of their cooperation in process of care delivery (76, 55.07%) were considered as serious or extremely serious barriers (Table 3).

Concerning the provision of healing environment, including sound and light control as well as group collaboration, the most important barriers were inappropriate NICU environments in terms of necessary equipment for delivery of care (93, 67.39%), lack of sufficient time and inappropriate NICU environment in terms of available space (88, 63.77%), high cost of developmental care in terms of NICU structure and equipment changes (77, 55.8%), lack of activity guideline (72, 52.17%), all given a score equal to 4 were indicating the presence of serious or extremely serious barriers (Table 3).

The most important barriers to delivery of family-centered care in the NICU were marked as follows: lack of sufficient time (100, 72.46%), inappropriate NICU environment in terms of available space for delivery of care by parents (81, 58.7%), inappropriate NICU environment in terms of necessary equipment for delivery of care and Lack of professional awareness (75, 54.35%), repeated requests by parents and lack of their cooperation in care delivery (71,

51.45%), were all regarded as serious or extremely serious barriers (Table 3).

Regarding pain and stress assessment and management as one of the core measures of neonatal developmental care, the most important barriers were lack of sufficient time (88, 63.77%), lack of activity guideline (78, 56.52%), inappropriate NICU environment in terms of necessary equipment for delivery of care (76, 57.07%), and inappropriate NICU environment in terms of available space for delivery of care (75, 54.35%) were all reported as serious or extremely serious barriers (Table 3).

In assessing nurses' opinions, a significant correlation was observed between familiarity of nurses with core measures of developmental care and attending in workshops and training courses. Concerning the barriers associated with establishment and implementation of different aspects of neonatal developmental care and work experience, Mann-Whitney statistical test showed a significant correlation regarding inappropriate physical environment in terms of necessary equipment between nurses with work experience less than 3 years (32, 49.23%) and those with work history of more than 3 years (47, 64.39%) ($P = 0.042$). In other words, those with longer work experience found it as a serious or extremely serious barrier to provision of developmental care. In addition, a significant relationship regarding lack of efficient collaboration with members of the treatment team between the nurses with

less than 3 years of work experience (33, 35.38%) and those with work history of longer than 3 years (40, 54.8%) was observed ($P = 0.048$). In fact, those with longer work experience mentioned the lack of effective team working as a serious or extremely serious barrier.

4. Discussion

A neonatal nurse is considered as backbone of the NICU, where a neonatal nurse is involved in team working, decision making, and providing clinical care to infants while supporting thousands of families with pre-mature or severely ill neonates. Therefore, NICU nurses are quite familiar with the needs of their patients and consequences of caregiving for such infants (3). Nurses have comprehensive understanding over the patients' needs and barriers to delivery of high quality care and these valuable pieces of information, produced by nurses through a self-reporting manner, could be used in scientific research (1). However, the NICU must have essential conditions for the provision of individual care to infants under developmental care including adjustable lighting according to infant's status, appropriate sound level, and minimal manipulation, especially those related to family-centered care and pain control, while in the same time, infant's protected sleep should be seriously considered (3). In our study, 80% of NICU nurses reported presence of extremely serious barriers to implementation of each aspects of developmental care.

Concerning activities of daily living as a job or major duty of nurses in providing comfort for infants and delivery of essential nutritional needs or supporting and caring of neonates for feeding with breast milk, skin care, and sleeping position by considering tucked position similar to position in the womb, our data showed that provision of such interventions in terms of delivery of developmental care is quiet possible, however, the barriers such as lack of sufficient time (62.32%), inappropriate space (55.07%), lack of necessary equipment (53.62%), repeated requests by parents and disturbance in delivery of daily routine care (50%), lack of awareness (47.1%), and high cost (43.48%) were described as extremely serious barriers, which negatively influenced practice of this significant aspect of developmental care in NICUs under the study.

If delivery of daily routine care faces extremely serious barriers, this substandard process of work activities will probably damage the infants' general health. The importance of this aspect of developmental care is reflected in a study that compared neurobehavioral performance in very preterm infants and NICU ranking, according to implementation of neonatal developmental care measures, and concluded that infants under developmental care in

terms of receiving appropriate daily routine care will have better attention and self-regulation responses (quality) later in their life and also with a more gentle personality compared to infants who were under a regular environment (1).

Concerning the preparation for providing necessary conditions for delivery of infant's protected sleep care, nurses have been facing several barriers. Researchers have demonstrated that implementation of developmental care could decrease the degree of environmental and behavioral stimuli in the NICU, which leads to sleep protection and care, causing harmonious development of infant's nervous system to proceed.

In regards to the barriers to provision of healing environment in NICUs, most nurses of the present study mentioned lack of sufficient time and inappropriate space (63.77%), lack of necessary equipment (67.39%), daily routine care (48.55%), high cost of developmental care (55.8%), and more important lack of knowledge over effect of developmental care on infants (50.72%) as extremely serious barriers. Considering these findings, it seems that the item marked as NICU inappropriate environments, in terms of available space and equipment and failure in changing NICU structure such as lighting system and sound control, to be major (extremely serious) barriers to circulation of developmental care measures in our NICUs.

Initially, the commencement of caregiving in the NICU, with regard to its type and unique structure, was solely intended to help and save the infant's life by easing the process of treatment. As the major commitment of caregivers was to save infants' life, the influence of adverse effects of physical environment was easily missed. Since saving ones life was the major criterion, unpleasant and standing questions on whether we have to be concerned over the possible side effects of physical environment on fragile infants or growing brain, were propounded for further discussion. Later, the answers to these questions increasingly appeared in the results of many different studies in terms of "yes" and not only for the neonate but also the family and even the caregivers who could be affected by physical environment. Interestingly, the personnel who are routinely working in the NICUs still ignore stressful factors while brain growth and development of premature babies are being formed at a speed higher than any other stage of life; a period in which millions of nerve cells and brain's wiring are being developed minute by minute for optimal or suboptimal functioning (18).

Concerning the provision of a healing environment, the NICU environment is a work place with different types of people (personnel, non-personnel) attending the site, requiring lighting to be on continuously, and involved in a three shift work schedule and rotation with different in-

dividuals. Under these conditions, attention has to be paid towards infants' growth and developmental needs and also to widespread interdisciplinary collaboration of NICU personnel and provision of adequate lighting for family either the visitor or resident companion. Having explained the impact of physical environment, it is worth mentioning that NICUs are still built as a large area for admission of several infants with a single lighting control system to put light of entire NICU environment on or off simultaneously instead of installing individualized adjustable light source (19).

Light setting is considered as an essential component of the NICU, however, if a preterm baby is exposed to strong light in NICU or during phototherapy for treating hyperbilirubinemia, the patient may suffer retinopathy of prematurity later in life with long-term complications. The recommended level of light in the NICU is between 300 - 500 lux. Observing light/dark cycles such as covering the roof of the incubator during the night or protecting eyes from direct strong light from different sources (lamps or sunlight) is done until the time when the baby is ready to go home and live under regular ambient light (19).

Sound and noise also change physiology and blood flow of the brain, leading to infant's sleep disturbance (20). In a study to investigate the barriers to delivery of developmental care in NICU, 80% of nurses mentioned the absence of light, sound, and sound meters in their NICUs whereas only 3% described that such measurements were routinely performed and investigated in their medical settings (3).

In our study, most nurses emphasized on inappropriate environments in terms of available space and necessary equipment (93%), more important on the high cost for delivery of developmental care due to NICU structure change (77%), and also lack of knowledge over principles of developmental care (70%), which all marked as extremely serious barriers. The reason for the presence of these barriers that prevent successful delivery of developmental care in the NICU is our failure in changing the structure of NICU and avoiding establishing a spacious area in the NICU for several infants admitted and placed next to each other.

Concerning delivery of family-centered care in the present study, the major barriers were lack of sufficient time (72.46%), inappropriate environment in terms of available space (81%), and lack of essential equipment (75%), which were all scored as extremely serious barriers. There was a significant difference regarding the lack of necessary equipment for delivery of family-centered care between nurses with a work experience less than 3 years and those with a work history over 3 years ($P = 0.42$). In other words, those with longer work experience found this barrier more important in failure to delivery of developmental care than those with shorter work experience and marked it as

serious and extremely serious barrier. These are present conditions of our NICUs while family centered care is currently considered as a caring philosophy in which cooperation between nurses and families is of prime importance; this composes functional basis for this philosophy. However, in certain conditions, type of designing and environment allocated to neonatal intensive care unit should not influence efficacy and success of family-centered care on families, infants, and nurses (13, 21-24).

Nowadays, NICUs doors are opened to parents, however, evidence shows that we still have difficulty in allowing parents have easy access to NICU, in particular from nurses' viewpoint. It seems that nurses themselves have mentioned the reasons for this problem in terms of lack of guideline (71%), lack of knowledge over effect of developmental care (68%), delivery of daily routine care (66%), and repeated requests by parents and lack of cooperation in the process of caregiving (75%), which were all reported as extremely serious barriers. These findings remind the personnel in charge of nursing that nurses also need to be educated and get in-depth familiarity with philosophy of developmental care; in addition, simultaneously efforts have to be made towards fast installation of better equipment in NICU if possible due to the fact that according to scientific findings, infants and in particular premature neonates in NICU will experience sever damage, especially on brain development and growth.

In a study on 146 nurses, 42% stated that expansion and generalization of developmental care could occur through interdisciplinary meetings in their NICUs. Interestingly, more than one third of nurses mentioned the most serious barrier to implementation of developmental care was due to lack of team work between physicians and nurses (3). These findings are in agreement with the results of the present study in which lack of efficient team work (nurse, head nurse, director of nursing, and physicians) (63%) and lack of experience in delivery of developmental care to infants (61%) were mentioned as extremely serious barriers. This indicates that lack of teamwork and negative perception in adopting neonatal developmental care among respondents of current study, are the major reasons in failure to widespread application of developmental care in our NICUs. In this regard, there was a significant correlation between nurses with work experience less than 3 years and those with a work history longer than 3 years ($P = 0.048$). In other words, those with longer work experience mentioned lack of efficient team working as a serious to extremely serious barrier.

Concerning pain, stress assessment, and management measure, results of the present study showed that more than 50% of nurses mentioned lack of sufficient time, inappropriate physical environment in terms of available

space, unsuitable equipment of NICU, lack of cooperation by parents in delivery of developmental care, and absence of efficient team working as important barriers to provision of developmental care. More importantly, lack of guideline (78, 56.52%) and lack of experience associated with caregiving to infants (96, 50%) were reported as extremely serious barriers. These findings indicate that the importance of developmental care is not only unknown at the level of nursing management and education, but also provision of such care is facing serious barriers as if the complications of painful therapeutic interventions while caring for the infants are not recognized.

4.1. Conclusion

Our data provided some information that clearly demonstrates the presence of high level barriers that prevent successful delivery of developmental care. Furthermore, these results, from a nurses' point of view, indicates that the lack of enough time and inappropriate physical environment (available space, essential equipment) are considered as extremely serious barriers to establishing principles of developmental care in NICUs, leading to imposing profound effect on nurses' work conditions. Considering the origin of developmental care, it is defined as caring for neonates offered by infants' parents. In these circumstances, if developmental care is established in the format of a new caring process accompanied with a comprehensive guideline, it will be rationally adopted by NICU nurses themselves, which will ease its further implementation of developmental care measures, due to the fact that the provision of developmental care to severely ill infants, in particular preterm newborns in the NICU, in an atmosphere different from intrauterine environment, is a vital issue for recovery through supplying growth requirements of hospitalized infants.

Acknowledgments

The present study was part of a master's thesis in neonatal intensive care nursing with code 533 of the Ethics Committee of the Research Council of Tehran University of Medical. The thesis had been supported by the Research Council and the Nursing and Midwifery Faculty of Tehran University of Medical Sciences, Tehran, Iran. We hereby thank all critical care nurses working in the study setting.

Footnotes

Authors' Contribution: Omolbani Rahimi: searching, data gathering, and writing the manuscript, Ahmad Reza Shamshir: data analysis. Zahra Godarzi, Nasrin Khalesi,

Omolbani Rahimi, Farin Soleimani and Nooredin Mohammadi: study design, data gathering, and writing the manuscript.

Conflict of Interests: Authors report no conflicts of interest. Authors alone are responsible for content and writing of this article.

Ethical Issues: After obtaining the approval of Ethics Committee of Tehran University of Medical Sciences, the researcher presented her introduction letter to hospitals of Tehran University of Medical Sciences and explained the objectives of study to the related authorities in hospitals. Then, the NICU nurses were told that they could participate in study if they were willing to. They were also informed that they could withdraw from the study anytime during the study without any effect on their work in the NICU.

Funding/Support: All the research financial and material support was supported by Tehran University of Medical Sciences.

References

1. Montirosso R, Del Prete A, Bellu R, Tronick E, Borgatti R; Neonatal Adequate Care for Quality of Life Study Group. Level of NICU quality of developmental care and neurobehavioral performance in very preterm infants. *Pediatrics*. 2012;**129**(5):e1129-37. doi: [10.1542/peds.2011-0813](https://doi.org/10.1542/peds.2011-0813). [PubMed: [22492762](https://pubmed.ncbi.nlm.nih.gov/22492762/)]. [PubMed Central: [PMC4074610](https://pubmed.ncbi.nlm.nih.gov/PMC4074610/)].
2. Newnham CA, Inder TE, Milgrom J. Measuring preterm cumulative stressors within the NICU: the neonatal infant stressor scale. *Early Hum Dev*. 2009;**85**(9):549-55. doi: [10.1016/j.earlhumdev.2009.05.002](https://doi.org/10.1016/j.earlhumdev.2009.05.002). [PubMed: [19520525](https://pubmed.ncbi.nlm.nih.gov/19520525/)].
3. Hendricks-Munoz KD, Prendergast CC. Barriers to provision of developmental care in the neonatal intensive care unit: neonatal nursing perceptions. *Am J Perinatol*. 2007;**24**(2):71-7. doi: [10.1055/s-2006-958156](https://doi.org/10.1055/s-2006-958156). [PubMed: [17260329](https://pubmed.ncbi.nlm.nih.gov/17260329/)].
4. Altimier L, Phillips RM. The neonatal integrative developmental care model: Seven neuroprotective core measures for family-centered developmental care. *Newborn Infant Nurs Rev*. 2013;**13**(1):9-22. doi: [10.1053/j.nainr.2012.12.002](https://doi.org/10.1053/j.nainr.2012.12.002).
5. Cone S. The impact of communication and the neonatal intensive care unit environment on parent involvement. *Newborn Infant Nurs Rev*. 2007;**7**(1):33-8. doi: [10.1053/j.nainr.2006.12.006](https://doi.org/10.1053/j.nainr.2006.12.006).
6. Hunt KN. *NICU: Environmental effects of neonatal intensive care unit on infants and caregivers*. Sourn Illinois University; 2011.
7. Bertelle V, Sevestre A, Laou-Hap K, Nagahapitiye MC, Sizun J. Sleep in the neonatal intensive care unit. *J Perinat Neonatal Nurs*. 2007;**21**(2):140-8. quiz 149-50. doi: [10.1097/01.JPN.0000270631.96864.d3](https://doi.org/10.1097/01.JPN.0000270631.96864.d3). [PubMed: [17505234](https://pubmed.ncbi.nlm.nih.gov/17505234/)].
8. Aita M, Johnston C, Goulet C, Oberlander TF, Snider L. Intervention minimizing preterm infants' exposure to NICU light and noise. *Clin Nurs Res*. 2013;**22**(3):337-58. doi: [10.1177/1054773812469223](https://doi.org/10.1177/1054773812469223). [PubMed: [23275433](https://pubmed.ncbi.nlm.nih.gov/23275433/)].
9. Bonan KC, Pimentel Filho Jda C, Tristao RM, Jesus JA, Campos Junior D. Sleep deprivation, pain and prematurity: a review study. *Arq Neuropsiquiatr*. 2015;**73**(2):147-54. doi: [10.1590/0004-282X20140214](https://doi.org/10.1590/0004-282X20140214). [PubMed: [25742585](https://pubmed.ncbi.nlm.nih.gov/25742585/)].
10. Weisglas-Kuperus N, Hille ET, Duivenvoorden HJ, Finken MJ, Wit JM, van Buuren S, et al. Intelligence of very preterm or very low birthweight infants in young adulthood. *Arch Dis Child Fetal Neonatol*.

- tal Ed. 2009;**94**(3):F196-200. doi: [10.1136/adc.2007.135095](https://doi.org/10.1136/adc.2007.135095). [PubMed: [18805824](https://pubmed.ncbi.nlm.nih.gov/18805824/)].
11. Montirosso R, Del Prete A, Bellu R, Tronick E, Borgatti R, Neonatal adequate care for quality of life study G. Level of NICU quality of developmental care and neurobehavioral performance in very preterm infants. *Pediatrics*. 2012;**129**(5):e1129-37. doi: [10.1542/peds.2011-0813](https://doi.org/10.1542/peds.2011-0813). [PubMed: [22492762](https://pubmed.ncbi.nlm.nih.gov/22492762/)]. [PubMed Central: [PMC4074610](https://pubmed.ncbi.nlm.nih.gov/PMC4074610/)].
 12. Post AC, Maree CM. Guidelines for the implementation of developmental care for preterm and sick neonates: paediatrics. *Prof Nurs Today*. 2009;**13**(1):38-42.
 13. Bieleninik L, Gold, C . Early intervention for premature infants in neonatal intensive care unit. *Acta Neuropsychologica*. 2014;**12**(2):185-213.
 14. Lester BM, Miller RJ, Hawes K, Salisbury A, Bigsby R, Sullivan MC, et al. Infant neurobehavioral development. *Seminars in Perinatology*. 2011;**35**(1):8-19. doi: [10.1053/j.semperi.2010.10.003](https://doi.org/10.1053/j.semperi.2010.10.003).
 15. Coughlin M, Gibbins S, Hoath S. Core measures for developmentally supportive care in neonatal intensive care units: theory, precedence and practice. *J Adv Nurs*. 2009;**65**(10):2239-48. doi: [10.1111/j.1365-2648.2009.05052.x](https://doi.org/10.1111/j.1365-2648.2009.05052.x). [PubMed: [19686402](https://pubmed.ncbi.nlm.nih.gov/19686402/)]. [PubMed Central: [PMC2779463](https://pubmed.ncbi.nlm.nih.gov/PMC2779463/)].
 16. Hamilton KE, Redshaw ME. Developmental care in the UK: a developing initiative. *Acta Paediatr*. 2009;**98**(11):1738-43. doi: [10.1111/j.1651-2227.2009.01431.x](https://doi.org/10.1111/j.1651-2227.2009.01431.x). [PubMed: [19650842](https://pubmed.ncbi.nlm.nih.gov/19650842/)].
 17. Wu C-L. *A pilot survey of nurses' attitudes and practice of developmentally supportive care in NICUs in Taiwan*. University of Washington, ProQuest Dissertations Publishing; 2009.
 18. White RD. Newborn intensive care unit environment of care: How we got here, where we're headed, and why. *Seminars in Perinatology*. Elsevier; 2011.
 19. Rizzo P, Rea M, White R. Lighting for today's neonatal intensive care unit. *Newborn Infant Nurs Rev*. 2010;**10**(2):107-13. doi: [10.1053/j.nainr.2010.03.007](https://doi.org/10.1053/j.nainr.2010.03.007).
 20. Brown G. NICU noise and the preterm infant. *Neonatal Netw*. 2009;**28**(3):165-73. doi: [10.1891/0730-0832.28.3.165](https://doi.org/10.1891/0730-0832.28.3.165). [PubMed: [19451078](https://pubmed.ncbi.nlm.nih.gov/19451078/)].
 21. Cooper LG, Gooding JS, Gallagher J, Sternesky L, Ledsky R, Berns SD. Impact of a family-centered care initiative on NICU care, staff and families. *J Perinatol*. 2007;**27** Suppl 2:S32-7. doi: [10.1038/sj.jp.7211840](https://doi.org/10.1038/sj.jp.7211840). [PubMed: [18034178](https://pubmed.ncbi.nlm.nih.gov/18034178/)].
 22. Hendricks-Munoz KD, Louie M, Li Y, Chhun N, Prendergast CC, Ankola P. Factors that influence neonatal nursing perceptions of family-centered care and developmental care practices. *Am J Perinatol*. 2010;**27**(3):193-200. doi: [10.1055/s-0029-1234039](https://doi.org/10.1055/s-0029-1234039). [PubMed: [19653141](https://pubmed.ncbi.nlm.nih.gov/19653141/)]. [PubMed Central: [PMC4410360](https://pubmed.ncbi.nlm.nih.gov/PMC4410360/)].
 23. Zhang X, Lee SY, Chen J, Liu H. Factors influencing implementation of developmental care among NICU nurses in china. *Clin Nurs Res*. 2016;**25**(3):238-53. doi: [10.1177/1054773814547229](https://doi.org/10.1177/1054773814547229). [PubMed: [25155801](https://pubmed.ncbi.nlm.nih.gov/25155801/)].
 24. Deng Q, Zhang Y, Li Q, Wang H, Xu X. Factors that have an impact on knowledge, attitude and practice related to kangaroo care: National survey study among neonatal nurses. *J Clin Nurs*. 2018. doi: [10.1111/jocn.14556](https://doi.org/10.1111/jocn.14556). [PubMed: [29893432](https://pubmed.ncbi.nlm.nih.gov/29893432/)].