



# Assessment of Physical Environment of Iran's Neonatal Tertiary Care Centers from the Perspective of the Neonatal Individualized Developmental Care

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## ABSTRACT

**Background:** Globally, it is estimated that approximately 13 million neonates are born prematurely each year. The development of the central nervous system in premature neonates continues outside of the uterus and in the environment of neonatal intensive care unit (NICU). This study aimed to evaluate the physical environment of hospital and nursery in Iran's tertiary care centers.

**Methods:** This cross-sectional study was conducted on a total of 23 NICUs of nine Universities of Medical Sciences, where students are trained in the neonatal fellowship course, from seven provinces of Iran, 20<sup>th</sup> July to 21<sup>th</sup> September 2015. Data analysis was performed using SPSS software, version 16, and descriptive statistics.

**Results:** In this study, four dimensions of physical environment of hospitals and NICUs including the accessibility of NICU, the physical environment of NICU, infants' bed space, and the sensory elements of bed spaces were evaluated. The obtained scores for each item was 41.17, 39.95, 38.83, and 39.28 out of 100, respectively. The highest mean score was 71.30 that was related to NICU temperature and ventilation considerations. The lowest mean score was 20, which was related to controlling over the movements around the infants' beds. The total mean score of the physical environment of hospital and NICU was 39.77.

**Conclusion:** According to the results, it is recommended to take appropriate action to develop physical space and infrastructures for neonatal care regarding developmental care along with other dimensions.

**Keywords:** Developmental care, NICU, Physical environment, Preterm neonate, Tertiary care center

## Introduction

The incidence of preterm birth is 9%, and it is estimated that approximately 13 million premature neonates are annually born worldwide (1). The World Health Organization reported that the prevalence of preterm birth in Iran is 12.9% (2). In the most of the cases, the hospitalization of premature newborns in neonatal intensive care unit (NICU) is inescapable. Recently, the survival rate of preterm births has been improved due to

the advancement of science and technology (3).

Given the fact that the development of the central nervous system occurs in the third trimester of pregnancy, in premature neonates it continues outside of the uterus and in NICU environment. Therefore, prematurity is a risk factor for neurodevelopmental disabilities (4). Premature neonates are exposed to an environment with no resemblance to the uterus and experience

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separation from the uterus support.

In NICU, the neonate is exposed to sound, light, frequent manipulation, and painful procedures (5). Among different wards, NICU is of paramount importance because of the extreme sensitivity of premature neonates. In NICU, parents and staff have such high levels of stress and face work and emotional problems during neonates' hospitalization (6-9). One of the factors affecting the stress of preterm neonate and family is the physical environment of hospital and NICU.

Hospital and NICU are strange sites for family and preterm neonate. Making the room home-like and personalized for family and neonate is one of the components of developmental care program. The other components might be arranging for family to stay near the hospital and diminishing the stress of preterm neonate and family. In addition, proper physical space of hospital can reduce the stress and fatigue of staff and increase staff's efficacy in providing safe services to patients and improve the quality of care and neonatal outcomes (10).

Heidelise Als has provided a developmental care model called Newborn Individualized Developmental Care And Assessment Program (NIDCAP). This model is widely used in NICUs to make extra-uterine environment similar to the uterus, prevent harmful effects of prematurity on the development of neonates, and improve their growth and development (11). In a study carried out in Spain, the staff reported the positive effect of NIDCAP on the physical environment of NICU (12).

Another study in Sweden assessed the effects of the implementation of NIDCAP in NICUs for 10 years and demonstrated reduced duration and cost of mechanical ventilation and hospitalization, as well as lower rate of intracerebral hemorrhage, neonatal sepsis, apnea, and neonatal mortality. Additionally, the implementation of NIDCAP increased the sense of responsibility of staff in neonate care and improved the infant-parent relationship and parents' self-confidence in interaction with their newborn (13).

A review mentioned several advantages of developmental care interventions and reported no major adverse effects (3). However, another systematic review demonstrated no positive effect of NIDCAP on short- or long-term neurodevelopmental outcomes (14). In order to provide a comprehensive NICU and developmental care, it is essential to evaluate and improve current status of NICUs and their infrastructures (15-19). This study aimed to assess the physical environment of hospital and nursery, including the accessibility of

nursery from the outside of and from within the hospital, the physical environment that nursery provided, and bed space and its sensory elements in tertiary care centers in Iran.

## Methods

### Type of study

This national survey was performed as a descriptive cross-sectional study.

### Tertiary care centers

This study was conducted on a total of 23 NICUs of nine type-1 Universities of Medical Sciences of seven provinces of Iran (Tehran, Shahid Beheshti, Iran, Tabriz, Mashhad, Isfahan, Shiraz, Kerman, and Ahvaz), where medical students are trained in the neonatal fellowship course.

### Data Collection

Data was collected using the checklist of developmental care program in hospital and NICU physical environment, which included 22 items in four domains of the accessibility of NICU (3 items), the physical environment of NICU (8 items), infants' bed space considerations (3 items), and the sensory elements of neonate care areas (8 items). The items were scored according to the 5-point Likert scale. The items of the checklist were elicited from the standard scale of NIDCAP Federation International (20).

### Validation

After translating the checklist to Persian language, it was assessed by 10 faculty members with a PhD degree in neonatal nursing or neonatology. Thereafter, the content and face validity were established by performing reforms.

### Procedures

After obtaining permission from the Neonatal Department of Health Ministry and correspondence with the Medical Universities of interest, samples were taken from Medical Universities of Tehran, Shahid Beheshti, Iran, Tabriz, Mashhad, and Shiraz (each three centers), Isfahan and Ahwaz (each two centers) and Kerman (one center). The checklist was completed in 23 NICUs of teaching hospitals affiliated to medical universities that were selected through non-random sampling method.

To avoid scoring disputes and eliminate bias, six trained nurses of neonatal units were selected. After passing an 8-hour theoretical training program, the course was completed through receiving practical education for completing the

checklist in NICU by the research team. Finally, the trained nurses were referred to the NICUs of the hospitals and completed the checklists under observation. Each staff was responsible for completing the checklist in three to four centers. Data was collected during 20<sup>th</sup> July to 21<sup>th</sup> September 2015. We assessed all of NICUs, where medical students were trained in the neonatal fellowship course; therefore, there was no sampling in this study.

### Statistical Analysis

Data analysis was performed using SPSS software, version 16, and descriptive statistics. Frequency tables and means were used to describe the data. As mentioned above, each item was scored from 1 to 5 (very weak to very good), and the mean scores were computed. The total score was ranged from 0 to 100, which was expressed as the percentage. The high scores indicated good condition of specific developmental care.

### Ethical Considerations

This study was a research project of the Neonatal Department of Health Ministry and permission of the study was obtained from the Research Ethics Committee of Shiraz University of Medical Sciences, Shiraz, Iran. In this study, all ethical standards were considered based on the Helsinki Declaration.

### Results

Overall, the total mean score of the physical environment of hospital and NICU was 39.28 (standard deviation (SD): 4.15, 95% confidence interval (CI): 37.98-41.57). As demonstrated in Table 1, the total mean score of the accessibility of NICU was 41.17 (SD: 5.65, 95%CI: 43.61-38.72), which was the highest score obtained in this study. In this dimension, the highest score was 44.35 for neonatal transport considerations, and the lowest score was 28.70 for the distance between delivery room and NICU (Table 2).

The total score of the physical environment of

**Table 1.** The mean score of various dimensions of the physical environment of hospital and neonatal intensive care unit

Domains	Mean (SD*)	95%CI** for mean	
The accessibility of NICU***	41.17 (5.65)	38.72	43.61
The physical environment of NICU	39.95 (5.23)	37.68	42.21
Infants' bed space considerations	38.83 (7.69)	35.50	42.15
The sensory elements of NICU	39.28 (4.51)	37.33	41.23
Total score	39.77 (4.15)	37.98	41.57

\* Standard deviation, \*\* Confidence interval, \*\*\* Neonatal intensive care unit

**Table 2.** The mean score of the items of the physical environment of hospital and neonatal intensive care unit

Items	Mean (SD*)	95%CI** for mean	
		Lower	Upper
<b>A: The accessibility of NICU***</b>			
Easy Access to NICU	38.26 (5.76)	35.77	40.75
Closeness of the NICU to delivery room	28.70 (21.60)	19.36	38.03
Neonatal transport considerations	44.35 (8.43)	40.70	48.00
<b>B: The physical environment of NICU</b>			
Home-like and personalized space for family	35.65 (8.43)	32.00	39.30
Separation of neonatal care areas from the other areas	41.74 (8.34)	38.13	45.35
Density and size of bed spaces considerations	43.48 (16.68)	36.26	50.69
Specific family spaces and facilities	40.00 (0.00)	40.00	40.00
Milking and breastfeeding facilities	33.91 (17.51)	26.34	41.49
Closeness to supportive services	39.13 (4.17)	37.33	40.93
Facilities in private staff areas	37.39 (6.89)	34.41	40.37
Location and facilities of nurses' station	47.83 (11.66)	42.78	52.87
<b>C: Infants' bed space considerations</b>			
Design and well arrangement of infants' bed space	43.48 (16.68)	36.26	50.69
Facilities for family participation	33.04 (9.74)	28.83	37.26
Facilities for families' personal belongings	40.00 (0.00)	40.00	40.00
<b>D: The sensory elements of neonate care areas</b>			
Lighting	29.57 (10.22)	25.15	33.98
Sound controlling	29.57 (14.61)	23.25	35.88
Controlling over the movements around the patient	20.00 (0.00)	20.00	20.00
Providing appropriate visual stimulation	23.48 (7.75)	20.13	26.83
Providing positive olfactory experience for neonates	60.00 (0.00)	60.00	60.00
Providing neonate positive taste experience for neonates	40.00 (0.00)	40.00	40.00
Providing neonate positive touch experience for neonates	40.00 (0.00)	40.00	40.00
NICU temperature and ventilation considerations	71.30 (10.14)	66.92	75.69

\* Standard deviation, \*\* Confidence interval, \*\*\*Neonatal intensive care unit

NICU was 39.95 (SD: 5.23, 95%CI: 37.68-42.21). As shown in Table 2, breastfeeding facilities had the lowest score of 33.91 (SD: 17.51, 95%CI: 26.34-41.49), and the location of nurses' station gained the highest score of 47.38 (SD: 11.66, 95%CI: 42.78-52.87). The total mean score of infants' bed space considerations was 38.83 (SD: 7.69, 95%CI: 35.50-42.15), which was the lowest score among the four domains.

In this dimension, facilities for family involvement in care planning obtained the lowest score of 33.04 (SD: 9.74, 95%CI: 28.83-37.26), and the arrangement of locating NICU beds had the highest score of 43.48 (SD: 16.68, 95%CI: 36.26-50.69). In the sensory elements of NICU, the total mean score was 39.28 (SD: 4.51, 95%CI: 37.33-41.23). In this domain, the highest score was allocated to the temperature and ventilation of NICU (mean: 71.30, SD: 10.14, 95%CI: 66.92-75.69), while the score of controlling over the movements around the beds had the lowest score.

## Discussion

This study aimed to evaluate the physical environment of hospital and NICU in four domains of the accessibility of NICU, the physical environment of NICU, infants' bed space, and the sensory elements of NICU in the hospitals affiliated to Medical Universities of seven provinces of Iran. In this study, these four domains were scored 41.17, 39.95, 38.83, and 39.28, respectively. Among the various statements of the domains, the greatest total mean score of 71.30 was related to NICU temperature and ventilation, and the lowest total mean score of 20 was allocated to controlling over the movements around the beds. Overall, the total mean score of the physical environment of hospital and NICU was 39.77.

Neonate hospitalization in NICU is a stressful and unpleasant experience for parents (21, 22). In the present study, the mean score of the accessibility of NICU (41.17) indicated inadequate attention to the NICU location within the hospital. In various countries, easy access to medical centers is a concept of great importance, which remarkably affects the neonatal health outcomes (23). For instance, it was indicated that neonatal mortality was associated with the distance to health facility (24). Therefore, the path to NICU should be clear from the entrance of the hospital by panel signs. The organizational structure of hospital should be designed in a way that NICU will be near the delivery room. Furthermore, specialized neonatal transport services such as well-equipped ambulances with trained health

care team should be provided.

In the physical environment of NICU, the total mean score was 39.95, which was the lowest score among the four domains. In this domain, breastfeeding rooms and the location of nurses' station gained the lowest and highest mean scores, respectively. In Iran, most of the NICUs have multiple bedrooms. Regarding the evidence, the recommended adjacent aisle was at least 2.4 m, which was needed for the passage of equipment and parents (25).

The NICU should be built near the other relevant wards and traffic to the other services should not pass through the NICU. In addition, the rooms should be equipped by private access to the hand-washing sink and toilet, phone or intercom linkage with the NICU staff, sleeping facilities for at least one person, and enough space for infant bed and equipment (25). To improve the physical space of NICU, appropriate colors should be used in the design of the rooms.

Additionally, in order to reduce the noise and traffic, the medication room and break room should be away from the care area. The space should be divided into the sections with four to six beds to provide the possibility of simultaneous presence of parents and healthcare providers. If all NICU beds are in a public hall, the beds should be separated by curtains. In this case, mothers can breastfeed their newborns by providing milk storage.

In the domain of infant bed space considerations, the total mean score was 38.83, which was the lowest among all the dimensions. The statements of the facilities for family participation, well arrangement of infant beds, and private or single-family room design were evaluated. The NICU should be equipped with a certain place for the presence of families. Facilities such as publications, internet, and audiovisual sources should be provided to train the families (25). These results were in line with results obtained by Nayeblouie et al. in 2013 (26).

The total mean score of the domain of sensory elements of the NICU was 39.28. This dimension included items such as lighting, noise controlling, minimizing traffic around the patient, and providing appropriate visual stimulations in early infancy, as well as providing positive experiences of olfactory, taste, touch, and proper temperature and ventilation of NICU. The mean score of this dimension was low.

Several studies investigated the light and noise in NICUs (27-30). A study that was conducted in 2014 showed that about 50% of the NICUs

provided appropriate light and sound (31). In another study, it was demonstrated that the sound level in NICU environment was always higher than the recommended level (32). According to the literature, the incubator covers had an effect on improving the sleep quality (33).

Moreover, dim light is prescribed during the day for staff. Generally, both natural and electronic light should be controlled (25). It is worth mention that light and sound measurements lead to environment optimization of and better implementation of developmental care program (34). The recommended temperature and moisture for NICU are between 22°C to 26°C and between 30% - 60%, respectively (25). In addition to the respiratory, nutritional, cardiac supports, it is essential to support the neurodevelopment of the neonate by soothing NICU physical environment. Given the results, only some aspects of this area have been considered and most of them have been ignored.

Considering the low scores of infant-centered care and staff-oriented care and the interaction of the components of developmental care, strengthening the physical environment of hospital and NICU can improve comprehensive NICU care (35, 36). Therefore, strategies and guidelines should be developed to enhance the physical environment of hospital and NICU. Several studies reviewed the developmental care domains of NICU including incubator covers, lighting, and noise controlling. In this study, 23 NICUs were evaluated with respect to the physical environment of hospital and NICU. The results could help us to consider the developmental care approaches in designing NICUs for promoting neonatal care.

## Conclusion

The total mean score of the physical environment of hospital and NICU was less than 50. The lowest score was related to infant bed space considerations and the highest score was allocated to the accessibility of NICU. The low scores of all domains, especially the dimension of infant bed space considerations, indicated that a serious intervention is needed to enhance the comprehensive NICU care. It is recommended to plan to upgrade developmental care by promoting the physical environment and the other domains.

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## Conflict of interest

There is no conflict of interest to declare.

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