

Estimation of Working Hours of Nursing Staff in Neonatal Intensive Care Units: A Work Sampling

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ABSTRACT

Background: Human resources are considered the most valuable capital of every healthcare system, and the quality of care is closely related to the quantity and skill of this group. Therefore, the proper estimation of the required nursing staff in different wards can help improve the quality of nursing care. The purpose of this study was to determine the hours of provided care by nursing staff in neonatal care units.

Methods: In this descriptive study, the research samples consisted of all nursing activities done by the nursing staff including head nurses, nurses, and nurse assistants working in the neonatal intensive care units of the chosen educational hospitals affiliated with Shahid Beheshti University of Medical Sciences in Tehran, Iran. Data collection tool was a nursing checklist with four categories, including direct care, indirect care, managerial activities, and personal activities. Calculating their activity duration was done using a stopwatch. Data analysis was performed by SPSS software (version 21).

Results: The obtained findings showed that the time allocated to direct care by head nurses and nurses in morning and evening shifts was always less than the time allocated to indirect care and the nurses spent most of their time doing indirect activities.

Conclusion: According to the obtained results of the present, it is essential that nursing managers provide the possibility of reducing some nursing activities' time by applying more accurate supervision and time management and thus increase the quality of care by providing purposeful healthcare.

Keywords: Iran, Neonatal intensive care unit, Nursing staff, Working hour, Work sampling

Introduction

Human resources in all parts of the health system, including hospitals, are the most valuable factor in service provision procedure, and nurses constitute the largest group of hospital staff (1, 2). Since nurses are considered as the core of care provision procedure (3, 4), the low quality of care provided by them has always been considered as a global challenge. One of the main causes of this poor quality care is insufficient human resources and the lack of skills (1, 5).

It has been confirmed that there is a relationship between insufficient nursing manpower and

increasing hospital complications as one of the indicators of nursing deficiencies in care procedure (2, 6-8). Hence, the researchers have always emphasized the relationship between nursing manpower and care outcomes. They believe that insufficient nursing manpower results in an increase in workload which ultimately increases the concerns about the quality of care provision (5, 9, 10).

Considering the increase in technology growth and birth rate of premature infants, the need for sufficient human resources in neonatal intensive

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care units (NICUs) has also risen; moreover, the importance and role of nurses have been highlighted (4, 11-13). Providing high-quality nursing care in NICUs requires a reasonable balance between nursing human resources and their skills in care provision. Due to the specific characteristics of the infants admitted to these units, the estimations of the quantity and expertise of nurses in NICUs differ from other hospital wards (14, 15).

The estimation of human resources is done in a variety of ways two of which are more applicable. The first method that measures nursing staff based on the number of beds in a hospital, has some deficiencies the most important of which is neglecting patients' needs. In the second method that is the estimation of the number of nurses based on the degree of patients' dependence, the focus is only on the physical dependence of patients and their other needs, such as psychological ones are not included that is considered a deficiency.

The two aforementioned methods are not appropriate for estimating human resources staff in NICUs especially due to the fact that the infants admitted to these units are dependent on nurses in terms of all needs (16). Accordingly, there are several methods and formulas for estimating human resources in intensive care units. One of the most important methods approved by many nursing associations in the world is Work sampling.

Due to the fact that the majority of the work procedures in Iran hospitals are not standardized and written, the best method for measuring workload and human resources is to apply work sampling (3, 16). This approach consists of four categories, including direct care, indirect care, managerial services, and nurses' personal activities (3, 17). Applying this method in NICUs results in measuring the number of necessary staff, determining workload for each person, evaluating the efficiency of wards, strategic planning in order to improve the service provision, designing the time schedule related to occupational activities, and the possibility of providing new services (18).

Considering a direct relation between the number of nursing staff and patients' outcomes, it seems necessary to measure the workload and thus the number of nurses (2). Also, due to the lack of evidence for estimating the required human resources needed in NICUs in Iran, the purpose of this study was to determine the

duration of nursing care provided in NICUs so that it can be applied to improve the condition of human resources and increase the quality of nursing care in NICUs.

Methods

In this descriptive study, the study population consisted of all nursing care services provided by the nursing staff in neonatal intensive care units. The samples consisted of all nursing care services provided by nursing staff in the NICUs of chosen educational hospitals affiliated with Shahid Beheshti University of Medical Sciences, including Mahdiyeh, Mofid, and Imam Hossein hospitals in Tehran, Iran, from August to September 2017.

In each shift, 70 activities were evaluated during one month in each hospital. The researcher was present in the ward at the beginning of each shift and measured the duration of activities using a stopwatch. For longer activities, the staff was provided with a stopwatch in order to inform the researcher about the duration of an activity as it was done.

Work sampling was done in these three hospitals as it follows (19): First, a list of nursing activities was prepared by reviewing texts and gathering staff's opinion. Then, through direct observing and measuring by the researcher who was a nurse, the required time for each activity was measured. In the timing process, there are three types of time as it follows:

1. Optimistic time (OT): It is calculated through observing and measuring the duration of activities in the best circumstances by the person with the stopwatch based on the staff's opinions.

2. Most likely time (MLT): It is the usual duration of nursing activities that are obtained through repetitive observation.

3. Pessimistic time (PT): It is calculated through observing and measuring the duration of activities in the worst circumstances by the person with the stopwatch based on the staff's opinions.

In order to calculate the expected time (ET) for each activity, the following equation was used according to the three above-mentioned times.

$$ET = \frac{OT + PT + 4MLT}{6}$$

Since there are some factors, such as unexpected delays, and fatigue, extra time should be deliberately added to the ET that is called tolerance. Eventually, a final coefficient was set for

each activity according to the following equation:

$$\text{Final coefficient} = \text{Tolerance} + 1$$

Calculating Adjusted Time

After calculating the adjusted time for each activity (through multiplying the final coefficient for each activity by the expected time for each activity), the total time allocated to a single activity during a month will be calculated through multiplying the modified time by the number of iterations of the activity during the month. The research tools consisted of a checklist of nursing activities with four categories, including direct care, indirect care, managerial activities, and personal activities. Direct care is a service that involves communication between the nurse and patient, while indirect nursing care is the patient-related services that do not require communication between the nurse and patient (20).

These checklists were prepared based on previous checklists designed for evaluating the workload of nurses working in intensive care units (19, 21, 22). In order to determine the validity of the checklists used in this study, content validity and face validity were measured. The checklist was given to 10 faculty members of the School of Nursing and Midwifery of Shahid Beheshti University of Medical Sciences and content validity was assessed by determining the content validity index in terms of its relevance.

The content validity indices of the checklists were measured as 0.97, 90.0, 0.94, and 0.90 for direct care, indirect care, managerial activities, and personal activities, respectively. The intra-class correlation coefficient (ICC) was calculated to assess the reliability of the type of checklist

activities. Nursing activities were evaluated by two observers and ICC was measured (ICC: 88%). In this study, SPSS software (version 21) was used for data analysis.

Code of Ethics

In this study, based on the human experimentation code of ethics in medical science studies (Local Ethics Committee in Medical Science Research, 2010), written informed consent was taken from the nurses.

Results

The duration of each activity is shown in details and specified by care services in three shifts (morning, evening, and night) and three ranks (head nurse, nurse, and nurse assistant) in hospitals A (Table 1), B (Table 2), and C (Table 3). The findings showed that the duration of indirect care provision for nurses was the longest among other types of care.

Discussion

Considering the importance and sensitivity of care provision for newborns hospitalized in NICUs and their dependence on nurses for all their needs, providing specialized and adequate manpower in order to deliver care in these units is essential (11, 12). There is a relation between the time allocated by a nurse to provide care for each patient and the patient's outcomes and errors in one side, as well as the patient, family, and nurse's satisfaction on the other side (23). As a result, in order to increase the efficiency of healthcare facilities, it is essential to evaluate the time spent on providing nursing care as one of the indicators of estimating the number of required nurses (18).

Table 1. Time of nursing staff's activities in neonatal intensive care unit in hospital A

Rank	Shift	Type of Activity	Total Time of Activity (min)	Percentage (Total)	Total Time (min)
Head nurse	Morning	Indirect care	2413.96	31	7724.07
	Morning	Direct care	163.96	2	
	Morning	Personal activities, rest break	1090.99	14	
	Morning	Ward managerial activities	4055.17	53	
Nurse	Morning	Indirect care	31042.33	46	68150.79
		Direct care	25521.62	37	
		Personal activities, rest break	4924.23	7	
		Ward managerial activities	6662.61	10	
Nurse	Evening	Indirect care	17263.03	46	377702.2
		Direct care	12267.39	32	
		Personal activities, rest break	3988.99	11	
		Ward managerial activities	4250.81	11	
Nurse	Night	Indirect care	32279.67	34	95864.87
		Direct care	39405.18	41	
		Personal activities, rest break	17673.02	18	
		Ward managerial activities	6507.00	7	

Table 2. Time of nursing staff's activities in neonatal intensive care unit in hospital B

Rank	Shift	Type of Activity	Total Time of Activity (min)	Percentage (Total)	Total Time (min)
Head nurse	Morning	Indirect care	4189.96	40	10403.59
		Direct care	151.56	1	
		Personal activities, rest break	2558.29	25	
		Ward managerial activities	3503.79	34	
Nurse	Morning	Indirect care	31096.25	44	70081.05
		Direct care	26038.33	37	
		Personal activities, rest break	7263.98	10	
		Ward managerial activities	5682.49	8	
Nurse	Evening	Indirect care	23384.88	40	59123.80
		Direct care	21189.97	36	
		Personal activities, rest break	9143.72	15	
		Ward managerial activities	5405.24	9	
Nurse	Night	Indirect care	42820.04	34	125708.79
		Direct care	57093.45	45	
		Personal activities, rest break	14635.26	12	
		Ward managerial activities	11160.03	9	

Table 3. Time of nursing staff's activities in neonatal intensive care unit in hospital C

Rank	Shift	Type of Activity	Total Time of Activity (min)	Percentage (Total)	Total Time (min)
Head nurse	Morning	Indirect care	5494.81	40	13682.87
		Direct care	238.04	2	
		Personal activities, rest break	1850.41	14	
		Ward managerial activities	6099.61	45	
Nurse	Morning	Indirect care	46827.81	46	102150.63
		Direct care	41975.20	41	
		Personal activities, rest break	7200.43	7	
		Ward managerial activities	6147.19	6	
Nurse assistant	Morning	Indirect care	4488.38	35	12831.11
		Direct care	3997.59	31	
		Personal activities, rest break	1748.30	14	
		Ward managerial activities	2596.84	20	
Nurse	Evening	Indirect care	31313.27	38	82444.98
		Direct care	34287.30	42	
		Personal activities, rest break	8059.27	10	
		Ward managerial activities	8785.14	11	
Nurse assistant	Evening	Indirect care	4411.62	41	10669.39
		Direct care	2382.15	22	
		Personal activities, rest break	2510.57	24	
		Ward managerial activities	1365.04	13	
Nurse	Night	Indirect care	65936.74	39	168775.2
		Direct care	77502.11	46	
		Personal activities, rest break	16336.65	10	
		Ward managerial activities	8999.75	5	

The purpose of this study was to calculate the time allocated to each type of care provided by the nursing staff in NICUs, based on a work sampling approach. By applying this approach, other than determining the number of required nursing manpower the usual time for doing these activities can be measured. According to the previous studies, direct care includes direct communicating with the patient or his/her family, bathing the patient, wound dressing, or other nursing procedures.

Indirect care includes checking test results, planning care services, washing hands, and surveying documents (23). According to the

findings of this study, the duration of providing direct care by nursing staff was the shortest among all activities. Nurses spent most of their time doing other activities, such as indirect activities. Regarding the estimation of required nursing staff based on work sampling approach, the findings of this study are consistent with the following ones. The results of a study conducted on 44 nurses in five 8-hour shifts in the wards of surgery and internal medicine showed that the total amount of direct care is lower than the standard, and both durations of direct and indirect care are almost equal.

The mean values of direct and indirect nursing

care duration were 21.5 ± 11.1 and 22.1 ± 10 min for each patient, respectively. Also, the duration of non-care activities in total, regardless of the number of patients was 47.3 min per 5 days of observation that was 9.32% of each nurse's working time (24). In addition, the findings of a study conducted by Kiekkas et al. (2005) about evaluating the duration time of nursing activities showed that 35.2%, 46%, and 18.8% of the nurses' time was spent for doing direct care, other care services, and personal development activities (25).

According to the literature, a study entitled "calculating the time of nursing care" was performed using the self-report approach in an intensive care unit in the UK within 7 days. In the aforementioned study, it was observed that 24%, 65%, and 11% of the nurses' time was spent for direct care, other types of care, and nurses' personal development activities (19). According to Desjardins et al. (2008), 38.2% and 67.2% of the nurses' time was allocated to direct care and other types of care (26).

At the same time, there have been many studies indicating that more time is spent providing direct care. For example, according to the results of a study conducted in 2014 in the intensive care unit, the total time of delivery was 27.5 h of which 27.4 and 2.1 h were spent on direct care and indirect care (18). In the review of nursing activities carried out by Abbey et al. (2012), 76 h of observation in 10 days showed that a total of 3081 activities were done by nurses out of which 1857, 986, and 140 activities were allocated to direct care provision (40.5% of total time), indirect care provision (32.4% of total time), and personal activities (21.9% of total time), respectively.

The remaining time was devoted to ward-related activities (17). The findings of another study about determining the care provision time in emergency wards, intensive care unit, and coronary care unit in Tabriz, Iran, showed that 32.74, 24.09, and 42.30 h were allocated to direct care, indirect care, and personal activities, respectively. The aforementioned study was carried out using the observational approach over a period of five weeks (27). However, based on the available guidelines, personal activities are usually estimated to contain 10%-20% of the total activities (19, 21, 28, 29). Direct care and the nurse's presence at the patient's bedside are the basis of nursing care to which most of the time should be allocated (27).

The differences between the results of this study and other studies are probably due to the

differences in the ward environment or type of patients (30), lack of proper programs for organizing nursing activities, advancements of technology, higher clinical skills (Consequently, less time is needed to spend on providing direct nursing care) in comparison to the previous years, application of scientific management methods or availability of written job descriptions that causes nurses to spend less time providing direct care.

The implementation of the accreditation program in hospitals can also be considered as a factor in reducing the time of providing direct care by nurses. Since in this program the documentation of nursing activities was highlighted as the most important measure to be taken by nurses (31). Thus, a lot of time was spent on written and non-nursing affairs. However, by reducing the time of providing indirect care, as well as written and non-nursing services through applying reforms on the physical environment, the accessibility of working equipment, communication methods, type of existing forms, or using software programs, the time allocated to direct care provision may be increased (32).

Applying proper management methods and reducing or eliminating some non-nursing activities also make nurses spend most of their time providing patients with direct care. Human resources are considered as the most important resources and the lack or excess of which can reduce the quality of services provided for patients. The majority of problems in hospitals, as the most important providers of health services in health systems, are the results of the lack of human resources or inappropriate distribution. The major part of hospital human resources consists of nurses who directly affect the quality of care and health promotion (33, 34).

Conclusion

Regarding the results of this study and given the emphasis on resource management and cost control, it is essential to become more familiar with management principles. Thereby nurse managers apply more accurate monitoring and time managing through adjusting time and reducing the duration of some nursing activities by designing a more appropriate care plan in order to make service provision more purposeful and increase the quality of care.

It is recommended to carry out further studies in children's and adults' intensive care units and in intensive care units of private hospitals in order to compare the results with the findings of this

study. One of the limitations of this study was the presence of the researcher in the ward that could have had an impact on the normal activity of the nurses. However, efforts were made to reduce the sensitivity through the continuous and longer presence of the researcher.

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Conflicts of interests

The authors declare that there is no conflict of interest.

References

- Spilsbury K, Hewitt C, Stirk L, Bowman C. The relationship between nurse staffing and quality of care in nursing homes: a systematic review. *Int J Nurs Stud.* 2011; 48(6):732-50.
- Twigg D, Duffield C. A review of workload measures: a context for a new staffing methodology in Western Australia. *Int J Nurs Stud.* 2009; 46(1):131-9.
- Williams H, Harris R, Turner-Stokes L. Work sampling: a quantitative analysis of nursing activity in a neuro-rehabilitation setting. *J Adv Nurs.* 2009; 65(10):2097-107.
- Badini Pourazar S, Shirinabadi Farahani A, Ghahri Sarabi A, Pourhoseingholi MA, Dehghan K. The effect of abdominal touch on nutritional tolerance in preterm infants. *Int J Pediatr.* 2018; 6(8):8119-28.
- Bradley S, Kamwendo F, Chipeta E, Chimwaza W, de Pinho H, McAuliffe E. Too few staff, too many patients: a qualitative study of the impact on obstetric care providers and on quality of care in Malawi. *BMC Pregnancy Childbirth.* 2015; 15(1):65-6.
- West E, Barron DN, Harrison D, Rafferty AM, Rowan K, Sanderson C. Nurse staffing, medical staffing and mortality in Intensive Care: an observational study. *Int J Nurs Stud.* 2014; 51(5):781-94.
- Rogowski JA, Staiger D, Patrick T, Horbar J, Kenny M, Lake ET. Nurse staffing and NICU infection rates. *JAMA Pediatr.* 2013; 167(5):444-50.
- Garcia PC, Fugulin FM. Nursing care time and quality indicators for the ICU: correlation analysis. *Crit Care.* 2013; 17(3):13-7.
- Padilha KG, de Sousa RM, Garcia PC, Bento ST, Finardi EM, Hatarashi RH. Nursing workload and staff allocation in an intensive care unit: a pilot study according to Nursing Activities Score (NAS). *Intensive Crit Care Nurs.* 2010; 26(2):108-13.
- de Magalhaes AM, Dall'Agnol CM, Marck PB. Nursing workload and patient safety--a mixed method study with an ecological restorative approach. *Rev Lat Am Enfermagem.* 2013; 21:146-54.
- Lawn JE, Davidge R, Paul VK, Xylander SV, de Graft Johnson J, Costello A, et al. Born too soon: care for the preterm baby. *Reprod Health.* 2013; 10(Suppl 1):S56.
- Ndelema B, Van den Bergh R, Manzi M, van den Boogaard W, Kosgei RJ, Zuniga I, et al. Low-tech, high impact: care for premature neonates in a district hospital in Burundi. A way forward to decrease neonatal mortality. *BMC Res Notes.* 2016; 9:28.
- Namnabati M, Taleghani F. Nursing satisfaction with medication care by using neonatal electronic medication management systems. *Iran J Neonatol.* 2017; 8(4):43-56.
- Rogowski JA, Staiger DO, Patrick TE, Horbar JD, Kenny MJ, Lake ET. Nurse staffing in neonatal Intensive Care Units in the United States. *Res Nurs Health.* 2015; 38(5):333-41.
- Bray K, Wren I, Baldwin A, St Ledger U, Gibson V, Goodman S, et al. Standards for nurse staffing in critical care units determined by: the British Association of Critical Care Nurses, The Critical Care Networks National Nurse Leads, Royal College of Nursing Critical Care and In-flight Forum. *Nurs Crit Care.* 2010; 15(3):109-11.
- Mark W, Stanton MA. Hospital nurse staffing and quality of care. *Prof Inferm.* 2005; 58(2):67-74.
- Abbey M, Chaboyer W, Mitchell M. Understanding the work of intensive care nurses: a time and motion study. *Aust Crit Care.* 2012; 25(1):13-22.
- Kakushi LE, Evora YD. Direct and indirect nursing care time in an intensive care unit. *Rev Lat Am Enfermagem.* 2014; 22(1):150-7.
- Harrison L, Nixon G. Nursing activity in general intensive care. *J Clin Nurs.* 2002; 11(2):158-67.
- Swansburg RC, Swansburg RJ. Introduction to management and leadership for nurse managers. Massachusetts: Jones & Bartlett Learning; 2002.
- Norrie P. Nurses' time management in intensive care. *Nurs Crit Care.* 1997; 2(3):121-5.
- Gardner GE, Gardner A, Middleton S, Gibb M, Della P, Duffield C. Development and validation of a novel approach to work sampling : a study of nurse practitioner work patterns. *Aust J Adv Nurs.* 2010; 27(4):4-12.
- Westbrook JI, Duffield C, Li L, Creswick NJ. How much time do nurses have for patients? A longitudinal study quantifying hospital nurses' patterns of task time distribution and interactions with health professionals. *BMC Health Serv Res.* 2011; 11:319.
- Heydari F, Tabari R. Identify direct and indirect nursing care time in a medical and surgical ward. *J Holist Nurs Midwifery.* 2015; 25(1):1-9.
- Kiekas P, Pouloupoulou M, Papahatzi A, Androutopoulou C, Maliouki M, Prinou A. Nursing activities and use of time in the postanesthesia care unit. *J Perianesth Nurs.* 2005; 20(5):311-22.

26. Desjardins F, Cardinal L, Belzile E, McCusker J. Reorganizing nursing work on surgical units: a time-and-motion study. *Nurs Leadership*. 2008; 21(3):26-38.
27. Gholizadeh M, Janati A, Nadimi B, Kabiri N, Abri S. How do nurses spend their time in the hospital? *J Clin Res Govern*. 2014; 3(1):27-33.
28. Bosman RJ, Rood E, Oudemans-van Straaten HM, Van der Spoel JI, Wester JP, Zandstra DF. Intensive care information system reduces documentation time of the nurses after cardiothoracic surgery. *Intensive Care Med*. 2003; 29(1):83-90.
29. Marasovic C, Kenney C, Elliott D, Sindhusake D. Attitudes of Australian nurses toward the implementation of a clinical information system. *Comput Nurs*. 1997; 15(2):91-8.
30. Padilha KG, Stafseth S, Solms D, Hoogendoorn M, Monge FJ, Gomaa OH, et al. Nursing activities score: an updated guideline for its application in the Intensive Care Unit. *Rev Esc Enferm USP*. 2015; 49:131-7.
31. Nomura AT, Silva MB, Almeida MA. Quality of nursing documentation before and after the Hospital Accreditation in a university hospital. *Rev Lat Am Enfermagem*. 2016; 24:e2813.
32. Bazi A, Sharafi S. Evaluation time nurses for non-nursing tasks and text services in nursing shifts: a cross-sectional study. *Navid Now J*. 2016; 19(62):24-32.
33. Jiang H, Li H, Ma L, Gu Y. Nurses' roles in direct nursing care delivery in China. *Appl Nurs Res*. 2015; 28(2):132-6.
34. Momennasab M, Karimi F, Dehghanrad F, Zarshenas L. Evaluation of nursing workload and efficiency of staff allocation in a trauma Intensive Care Unit. *Trauma Mon*. 2018; 23(1):e58161.