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ASSESSMENT OF THE NURSING WORKLOAD IN INTENSIVE CARE UNITS FOLLOWING CARDIAC SURGERY USING THE NURSING ACTIVITIES SCORE IN RELATION TO REGULATIONS IN SERBIA

PROCENA OPTEREĆENJA MEDICINSKIH SESTARA NA ODELJENJU INTENZIVNE NEGE POSLE KARDIOHIRURGIJE KORIŠĆENJEM SKORA SESTRINSKIH AKTIVNOSTI U ODNOSU NA PROPISU U SRBIJI

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Summary

Introduction. The Nursing Activities Score is used to quantify, assess, and identify the workload of nurses in intensive care units, and is widely considered a very effective, simple, standardized measurement scale, sufficiently detailed to be implemented in everyday hospital practice. The aim of the study is to evaluate the workload of nurses using the results of the Nursing Activities Score and compare the nurse-to-patient ratio with regulations in our country. **Material and Methods.** The study included 131 patients who underwent cardiac surgery in the period from November 1 to November 30, 2021. Surgical data and corresponding Nursing Activities Score values were obtained from hospital information system. In the intensive care unit, nursing activities were monitored and scored daily. **Results.** Using the Nursing Activities Score, 344 measurements were recorded in the study sample. The mean Nursing Activity Score was 88.27 ± 3.63 , and the highest was 102.97 ± 1.89 on the first postoperative day. The nurse-to-patient ratio was 1.03:1 on the first postoperative day, and about 0.8:1 on the second and third postoperative days. There was a statistically significant difference in the mean Nursing Activities Score between postoperative days ($p < 0.0005$) between the first and second day (102.96 vs. 79.46) and the first and third day (103.46 vs. 83.58). **Conclusion.** On the first postoperative day, the optimal number of nurses according to the Nursing Activities Score is higher compared to the State Regulations, while for the rest of the days in the intensive care unit the nurse-to-patient ratio corresponds to the regulations.

Key words: Workload; Intensive Care Units; Cardiac Surgical Procedures; Nursing Care; Nursing Staff; Hospital; Government Regulation

Introduction

Cardiac surgery procedures stand out as some of the most intricate and complex surgical interventions. Patients who have undergone cardiac surgery require specialized care to provide successful postoperative recovery. The introduction of new procedures in everyday

Sažetak

Uvod. Skor sestrinskih aktivnosti koristi se za kvantifikaciju, procenu i identifikaciju radnog opterećenja medicinskih sestara u odeljenjima intenzivne nege i uopšte smatra se veoma efikasnom, jednostavnom, standardizovanom skalom, dovoljno detaljnom za primenu u svakodnevnoj bolničkoj praksi. Cilj studije je da proceni opterećenje medicinskih sestara korišćenjem rezultata ovog sistema i uporedi odnos medicinska sestra/pacijent sa regulativom u našoj zemlji. **Materijal i metode.** Istraživanje je sprovedeno među 131 pacijentom, podvrgnutom kardiološkoj operaciji, u periodu od 1. do 30. novembra 2021. godine. Hirurški podaci i odgovarajuće vrednosti Skora sestrinskih aktivnosti dobijeni su iz bolničkog informacionog sistema. Na odeljenju za intenzivnu negu, pacijenti su svakodnevno ocenjivani korišćenjem ovog sistema i praćene su sestrinske aktivnosti. **Rezultati.** Korišćenjem Skora sestrinskih aktivnosti zabeležena su 344 merenja u uzorku studije. Srednja vrednost Skora bila je $88,27 \pm 3,63$, a najviša $102,97 \pm 1,89$ za prvi postoperativni dan. Prema Skoru, odnos sestra-pacijent za prvi postoperativni dan bio je 1,03 : 1, a za drugi i treći dan 0,8 : 1. Postojala je statistički značajna razlika u srednjim vrednostima Skora između postoperativnih dana ($p < 0,0005$), između prvog i drugog dana (102,96 vs 79,46) i prvog i trećeg (103,46 vs 83,58). **Zaključak.** Za prvi postoperativni dan, potreban broj medicinskih sestara, koji je izračunao Skor sestrinskih aktivnosti, veći je u poređenju sa državnim regulativom; za ostale dane boravka u intenzivnoj nezi, odnos sestre-pacijent odgovara definisanim propisima.

Glavne reči: opterećenje poslom; jedinice intenzivne nege; kardiološke procedure; sestrinska nega; bolničko osoblje; državna regulativa

clinical practice and on-going advances in surgical treatment and in intensive care units (ICUs) require continuing education of all members of healthcare teams participating in the treatment of these patients [1, 2].

Contemporary cardiac surgery intensive care units (CSICUs) demand enhanced, complete and continuous cardiovascular invasive hemodynamic monitoring.

Abbreviations

ICU	– intensive care unit
CSICUs	– cardiac surgery intensive care units
LOS	– length of stay
NAS	– Nursing Activity Score
POD	– postoperative day

Adequate planning, organization, evaluation and analysis of nurse workload are indispensable, not only for determining the optimal number of nurses but also for providing quality health care [3, 4].

Recent results indicate that a reduced number of nurses decrease the quality of health care, which in turn increases the risk of nosocomial infections and decubitus, postoperative complications, mortality, and length of stay (LOS) [5–7]. A constant increase in the number and complexity of nursing activities in ICUs has led to a significant increase in the nursing workload, as well as establishment of a wide range of methods for its measurement [2, 8].

Various workload scoring systems have been developed to determine the extent of nursing activities in ICUs and to assess the required number of nurses and their workload [9, 10]. Clinical studies showed that nurses spend a higher percentage of time on some activities that were not included in previous scoring systems and the Nursing Activities Score (NAS) was developed in 2003 as a new scale [11]. The score is based on the time consumed by nurse activities at the patient level, regardless of the severity of the health condition of the patient being cared for. It is one of the instruments used to measure the workload of nurses and is considered a very efficient, simple, standardized measurement scale, applicable in everyday hospital practice [12–14].

The study aims to:

Assess the nursing workload in intensive care units after cardiac surgery by using NAS;

Determine the optimal number of nurses per patient in an ICU using NAS and compare it with the state nurse staffing regulations.

Material and Methods

This prospective observational study was conducted in the regional tertiary-care university hospital (Car-

diovascular Surgery of the Institute of Cardiovascular Diseases of Vojvodina, Serbia) over a period of a month, between November 1 and 30, 2021 at the Cardiac Surgery Clinic. Data were collected prospectively from patients who underwent coronary or valvular surgery and combined coronary and valvular procedures. Patients with congenital heart defects, aortic dissections, and heart tumors were excluded from the study.

The sample included 131 patients who stayed in the ICU more than six hours. The grading was done daily, in the morning hours before leaving for the department. The data were taken from the hospital information system and analyzed in relation to the type of surgery, age, LOS in the ICU, and the activities of nurses in the ICU after cardiac surgery. During their stay in the ICU, the patients were scored by nurses using the NAS system, which is routinely performed in our ICU, as proposed by Miranda DR. et al. [11]. The NAS system has 23 items ranging from 1 to 177. The NAS above 100 indicates that the needed care can only be provided by more than one nurse. According to the NAS system, the optimal activity of nurses during a 24-hour period per patient equals 100 [15], which equals a nurse-to-patient ratio of 1:1 [15–17].

Statistical data processing was carried out using IBM SPSS 17 software and data analysis was performed using descriptive and inferential statistical methodologies. Numerical features are presented in means (arithmetic mean, median) and in measures of variability (range of values, standard deviation (SD)), and attribute features according to frequency and percentage. Student's t-test and Mann-Whitney test were used to compare differences between the mean values of numerical variables. The level of statistical significance of $p < 0.05$ was considered statistically significant. The results are presented in tabular form.

Results

Out of a total of 131 patients, coronary surgery was performed in 38.2% (50/131), 40.5% of patients underwent valvular surgery (53/131), and 21.4% of patients had combined procedures (28/131). There were less female patients, accounting for 35.9% (47/131) compared to 64.1% (84/131) of male patients.

Table 1. Mean length of stay, length of stay in intensive care unit, age and Nursing Activity Score

Tabela 1. Srednje vrednosti trajanja hospitalizacije, dužine boravka u jedinici intenzivne nege, godine života i Skor sestrinskih aktivnosti

	Number of patients Broj pacijenata	Minimum Minimalno	Maximum Maksimalno	Mean/Srednja vrednost	SD SD
Length of stay (in days) Dužina ležanja u bolnici (po danima)	131	7.00	42.00	12.32	6.03
Length of stay in intensive care unit (in days) Dužina boravka u intenzivnoj jedinici (po danima)	131	0.68	24.92	1.77	0.45
Age (years)/Godine života	131	32	82	66.10	9.13
Cumulative Nursing Activity Score Zbirni Skor sestrinskih aktivnosti	131	154.60	893.85	231.90	130.48
Nursing Activity Score/24 h Skor sestrinskih aktivnosti/24 h	131	77.30	110.70	88.27	3.63

Legend: SD - standard deviation/Legenda: SD - standardna devijacija

Table 2. Comparison of pairs of mean Nursing Activity Scores (NAS) in relation to the postoperative day
Tabela 2. Poređenje parova srednjih vrednosti Skora sestrinskih aktivnosti (SSA) u odnosu na postoperativni dan

	NAS/SSA	Number of patients/Broj pacijenata	Mean/Srednja vrednost	SD/SD	p/p
Pair 1/Par 1	POD1	131	102.96	1.89	< 0.0005
	POD2	131	76.46	5.96	
Pair 2/Par 2	POD1	35	103.46	1.58	< 0.0005
	POD3	35	83.58	13.25	
Pair 3/Par 3	POD2	35	83.07	7.76	0.788
	POD3	35	83.58	13.25	

Legend: SD - standard deviation; POD - postoperative day/Legenda: SD - standardna devijacija; POD - postoperativni dan

Table 3. Mean Nursing Activity Scores in the first three postoperative days and nurse-to-patient ratio
Tabela 3. Srednje vrednosti Skora sestrinskih aktivnosti za tri postoperativna dana, odnos medicinska sestra/pacijent

Postoperative day Postoperativni dan	Number of patients/Broj pacijenata	Nursing Activity Score/Skor sestrinskih aktivnosti				Nurse-to-patient ratio Odnos sestra-pacijent
		Minimum Minimalno	Maximum Maksimalno	Mean/Srednja vrednost	SD SD	
POD1	131	94.10	111.30	102.97	1.89	1.03:1
POD2	131	60.50	104.70	76.46	5.96	0.76:1
POD3	35	68.70	138.80	83.58	13.25	0.84:1

Legend: SD - standard deviation; POD - postoperative day/Legenda: SD - standardna devijacija, POD - postoperativni dan

The total number of performed NAS measurements for all patients during their LOS in the ICU was 344. The average age was 66.10 ± 9.13 years. The mean NAS was 88.27 ± 3.63 , and the mean cumulative value was 231.9 ± 130.48 . Mean LOS, age and NAS values are shown in **Table 1**.

On the second and third postoperative day (POD), 35 patients (26.7%) remained in the ICU. The mean NAS on the POD1 was 102.96 ± 1.89 , on POD2 it was 76.46 ± 5.96 , and on the POD3 it was 83.58 ± 13.25 . There was a statistically significant difference between the average NAS on the first and the second day, as well as between the first and the third day ($p < 0.0005$) (**Table 2**).

Table 3 shows the required number of nurses, i.e. the optimal number of nurses, based on the mean NAS on the first three PODs (nurse-to-patient ratio). During the POD1 each patient needed a nurse for 24 hours (1.03:1); on the following days, the number of required nurses was reduced to 1/5 (0.76:1; 0.84:1).

Discussion

Assessment of the nursing workload and patient needs is a prerequisite for adequate staffing and optimal allocation of nurses in an ICU since it provides quality service [3, 18, 19]. This is very important for hospital management and planning appropriate number of nurses [7–9].

In several studies, the NAS model was used to measure and analyze the nursing workload in cardiac surgery ICUs. A study [20] undertaken in a tertiary University CSICU, shows that the mean daily NAS was 74.6 points, and the mean value on the POD1 was 96.76. The results of Portuguese researchers [21] showed that the workload of nurses per patient on the POD1 in the ICU was 80.52

± 10.89 , i.e. it was higher compared to the later stay by 19.36 ± 2.61 . In our study, the mean daily NAS on the POD1 gave a similar result of 102.94 ± 4.01 .

The mean NAS in our study decreased during the ICU course by PODs (POD1 - 102.97, POD3 - 83.58), which suggests that patients needed the most intensive supervision and care following their arrival from the operating room, or on the POD1, which is in agreement with the results of other authors [22].

Similar mean NAS values were also obtained in other studies. In a highly specialized clinic for cardiac surgery, the mean value of NAS was found to be 73.7 [17].

Researchers in Belgium carried out two studies to assess the nursing workload and validate the NAS system in their ICUs [19, 23]. The reason for introducing NAS scoring system was to provide a better quality of healthcare and to assess the nurse-to-patient ratio. The mean NAS values in these studies were 69%, 76% [23], and 68.6% [19]. In addition, they validated the reliability of the NAS in their hospitals and found that it is a valid instrument which allows a reliable assessment of the nursing workload.

The authors [13] conducted a systematic analysis of a large number of articles and found that NAS ranged from a minimum 36.1 in Greece, to maximum 109.3 in Iranian patients, while in Norwegian studies NAS was 96.24 ± 22.35 , 88.4 ± 16.2 and 88.7 ± 24.5 . In our study, the mean NAS in our population was 88.27 ± 3.63 and it is most similar to the mean NAS obtained in Norway [24].

During the observation period of our study, on the POD1 the mean NAS was 102.97, which implies that the nurse-to-patient ratio was 1.03:1. On the POD2 and POD3, the NAS ranged from 76 - 84 points (on the POD2 it was 76.46, on the POD3 it was higher - 83.58).

Our results show that the number of nurses in relation to the needs of patients according to the NAS system after the POD1 was 20% lower, giving a ratio of about 0.8:1 (0.76:1 on the POD2, 0.84:1 on the POD3). This is understandable, since patients need the most intensive care and supervision immediately upon arrival from the operating room, i.e. on POD1. The results of a Belgian study using the NAS system showed that the optimal nurse-to-patient ratio was 1:1.5 in various ICUs [19].

Healthcare legislation in our country stipulates that the nurse-to-patient ratio in ICUs should be 0.8:1 [25]. In our study, we found that the required number of nurses per patient in CSICU on POD1 is higher than the number of nurses foreseen by the relevant legislation.

According to Belgian legislation, the nurse-to-patient ratio should be 1:3, while the results of a study conducted in several Belgian hospitals showed that the optimal number of nurses should be twice as high [19]. In Norway, a standard nurse-to-patient ratio has been set at 1.3:1 [24].

The assessment of the reliability of the NAS system shows that some of its practical applications may have certain shortcomings, and attempts have been made in some countries to improve this scoring system [16, 26, 27]. Although variations in the results have been observed, the NAS system has been translated into many languages and has been used in many countries to assess the workload of nurses which is an essential component for planning the required number of nurses and their schedules according to individual patient needs [13, 14, 23].

As each ICU has its own characteristics, it is very difficult to provide recommendations for the optimal number of nurses per patient [9, 10, 27, 28]. An analysis of a database containing several similar studies concluded that nurse-to-patient ratios that were calculated using the NAS system were higher than the nurse-to-patient ratios stipulated in the legislation of corresponding countries [12].

Conclusion

The use of the Nursing Activities Score to evaluate nursing workload in intensive care units facilitates an objective assessment of the optimal nurse-to-patient ratio. As per the Nursing Activities Score system, the most significant surge in nursing workload occurs on the initial postoperative day, where the nurse-to-patient ratio slightly surpasses 1:1. This ratio gradually declines during the postoperative recovery period, reaching approximately 0.8:1 on the second and third postoperative days. Remarkably, on the first postoperative day, the number of nurses required as indicated by Nursing Activities Score surpasses the stipulations outlined in our country's regulations.

To validate our findings, further research in the region could provide valuable insights and recommendations regarding potential adjustments to prevailing regulations pertaining to nursing staff prerequisites in both cardiac surgery intensive care and other intensive care units.

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