



## Assessment of workload in the postoperative period of cardiac surgery according to the *Nursing Activities Score*

Avaliação da carga de trabalho no pós-operatório de cirurgia cardíaca segundo o *Nursing Activities Score*

Evaluación de la carga de trabajo en el postoperatorio de cirugía cardíaca según la *Nursing Activities Score*

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### ABSTRACT

**Objective:** Identify factors associated with the workload of nursing care for patients in the postoperative period of cardiac surgery. **Method:** Prospective cohort study conducted with 187 patients in the surgical intensive care unit (ICU) of the *Instituto do Coração* (Heart Institute) in São Paulo-Brazil. Data were collected at 24 and 72 hours of the patients' admittance in the ICU. The dependent variable was workload as calculated by the Nursing Activities Score (NAS). The independent variables were demographic and clinical, as well as mortality scores. For data analysis, the Wilcoxon-Mann-Whitney test and Spearman correlation were used, and linear regression with mixed effects model. **Results:** The majority of patients were male (59.4%), with a mean age of 61 years ( $\pm 12.7$ ), and 43.9% developed some kind of complication in the postoperative period. In the first 24 hours, the workload was 82.4% ( $\pm 3.4$ ), and 58.1% ( $\pm 3.4$ ) in 72 hours. Factors associated with increased NAS were: patient's length of stay in the ICU ( $p=0.036$ ) and the presence of complications ( $p<0.001$ ). **Conclusion:** In contrast to numerous other studies, the severity of the patient's condition in the first 24 hours of the postoperative period did not increase workload, the increase was associated with length of stay in the ICU and complications.

### DESCRIPTORS

Nursing Care; Workload; Cardiovascular Surgical Procedures; Organ Dysfunction Scores; Perioperative Nursing; Intensive Care Units.

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## INTRODUCTION

The Nursing Activities Score (NAS) is considered to be a very sensitive instrument for assessing workload, and also in assisting in the planning of nursing human resources<sup>(1-4)</sup>. The activities included in the NAS, which includes 23 items, portray the need for care of a seriously ill patient during the first 24 hours<sup>(5-6)</sup>. Although the NAS is widely used in intensive care units (ICU) of different specialties<sup>(7-9)</sup>, its application in specific settings, such as postoperative care of cardiac surgery, is still limited<sup>(10-11)</sup>.

The NAS findings have indicated that sociodemographic<sup>(6-7)</sup> and clinical variables,<sup>(7)</sup> length of stay in the ICU<sup>(11)</sup>, mortality<sup>(8)</sup> and severity of the patient's conditions<sup>(8, 10, 12)</sup> are factors associated with the high workload of the nursing staff. Studies conducted with patients in the postoperative period of cardiac surgery showed that, in the first 24 hours, the nursing workload ranged from 61.6% to 96.8%<sup>(10-13)</sup>. In addition, the authors observed that, in this population, the NAS was associated with adverse outcomes such as increased length of stay in the ICU, complications and mortality<sup>(13-15)</sup>.

The clinical complexity of the patient's condition, highly specific care in the postoperative period, the sophistication of the treatment regimen and daily use of circulatory and respiratory support technology are elements that can directly impact nursing workload. Considering this scenario and that scientific production in the specialty has analyzed the NAS as one of the contributing variables to a given outcome, this study aimed to identify factors associated with the nursing workload required in the care of patients in the postoperative period of cardiac surgery. Analysis of the NAS as the response variable can provide a broader view of this workload, and additionally, can contribute, together with other elements in the planning and sizing of human resources, to promote quality of care and patient safety<sup>(2, 7)</sup>.

## METHOD

This was a prospective cohort study undertaken in the adult surgical ICU (ASICU) of the Heart Institute (InCor) do Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo-Brazil. InCor is a public and tertiary level teaching hospital specializing in cardiopulmonology, and has 446 beds. The ASICU has 40 beds, and mainly cares for patients in the postoperative period of cardiac, thoracic and pulmonary surgery, and lung and heart transplants.

The convenience sample was composed of adult patients ( $\geq 18$  years) admitted to the ASICU from July 30 to September 30, 2014, in the postoperative period of cardiac surgery (surgical myocardial revascularization, valve replacement and surgery of the aorta – aneurysm correction or dissection), who agreed to participate in the study, and whose minimum stay in the unit was 24 hours. At the request of the health care institution, patients with private health insurance plans, and those that died in the first 24 hours, were excluded from the study.

The research project was approved by the Research Ethics Committee of the Heart Institute (InCor) do Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo under the Protocol No. 4076/14/056, according to reso-

lution no. 466/2012 of the National Health Council, in Brazil. On the day prior to surgery, all the patients included in the study signed a free and informed consent form.

Sources of data collection were the patients' medical charts and evaluation of care provided to them. Two instruments were used, one being the NAS and the other composed of demographic and clinical development variables.

The workload as measured by the NAS, registered at 24 and 72 hours in the postoperative period, was considered the dependent variable. The NAS was applied retrospectively. Each point of the NAS score amounts to 14.4 minutes of nursing care, and the value of the score is obtained by the sum of points, which are expressed as a percentage of time spent by a nurse providing direct care to a patient. Twenty-three items are evaluated, divided into seven categories related to basic care activities, respiratory support, cardiovascular support, renal support, neurological support, metabolic support and specific interventions, totaling 32 activities. Each activity has a score that ranges from 1.2 to 32 points, reaching a maximum of 176.8% of time spent with a patient in 24 hours of work<sup>(5-6)</sup>.

The independent variables were: sex, age, type of surgery (coronary artery bypass grafting, valve replacement or surgery of the aorta), length of stay (LOS) in the ASICU, clinical condition at exit from the unit, left ventricular ejection fraction (LVEF), body mass index (BMI), cardiopulmonary bypass time (CPBT), mechanical ventilation for more than 48 hours (MV > 48 h) and surgical procedure related complications (bleeding, tamponade, reoperation, acute kidney injury (AKI), low cardiac output (CO) and arrhythmias). Additionally, scores of severity and the patient's morbidity and mortality risk were used as the Simplified Acute Physiology Score (SAPS 3), the Sepsis-related Organ Failure Assessment (SOFA) and the European System for Cardiac Operative Risk (EuroSCORE).

The SAPS 3 is a prognostic index that evaluates data concerning the early hours of the patient's stay in the ICU by 20 variables, which are divided into: personal history and socio-demographic data, causes of admission to the ICU and physiological variables. Each item has a score or weight, and, in the end, all the values are summed, with the smallest score being 16 points and the highest 217, so that the higher the score, the greater the observed severity<sup>(16-17)</sup>. Data collected at 24 hours in the ICU were used to calculate this score.

The SOFA evaluates the organic dysfunction of each system, and a score of 0 to 4 points is assigned for each variable. The variables analyzed are: bilirubin, oxygenation, use of vasoactive drugs, values of mean arterial pressure and platelet count<sup>(18-19)</sup>. For each function, a score of 3 or 4 indicates failure. The SOFA was calculated at 24 and 72 hours of the patient's stay in the ICU.

The EuroSCORE is a model of risk stratification to predict the risk of mortality in patients in the postoperative period of cardiac surgery from data related to the perioperative period, by means of evaluation of 17 risk factors grouped into: patient-related factors, factors related to the cardiovascular system and factors related to surgery. According to the score, the patient is classified into groups of low (0-2), medium (3-5) and high (score greater than 6) risk of mortality in the postoperative period after cardiac surgery<sup>(15, 20)</sup>.

The Statistical Package for the Social Sciences (SPSS) version 22 was used for statistical analysis of the data. The Wilcoxon-Mann-Whitney test was used in the analysis of categorical variables, and the Spearman correlation test was used for continuous variables. All variables that had a correlation with the NAS with  $p < 0.02$  were selected to be tested on the model. A linear mixed effects model was used in the longitudinal analysis of the NAS to identify the factors associated with the increase in nursing workload.

## RESULTS

From the 282 eligible patients, 95 were excluded: 92 patients had private health insurance, two died before completing 24 hours in the ASICU, and the procedure was suspended for one patient due to the condition of the surgical site. Thus, the sample included 187 patients, whose mean age was 61 years ( $SD = \pm 12.7$ ), mean BMI 26  $\text{Kg/m}^2$  ( $SD = \pm 4.8$ ), and mean length of stay in the ASICU was 5.5 days ( $SD = \pm 6.2$ ). Other sociodemographic and clinical variables are described in Table 1.

**Table 1** - Demographic and clinical profile of patients undergoing cardiac surgery - São Paulo, São Paulo, Brazil, 2014.

Variable	n	%
<b>Sex</b>		
Male	111	59.4
<b>Ethnic group</b>		
White	155	82.9
<b>Surgical myocardial revascularization</b>		
No	96	51.3
<b>Valve surgery (valve repair or replacement)</b>		
No	106	56.7
<b>Surgery of the aorta</b>		
No	168	89.8
<b>Cardiopulmonary bypass (CPB)</b>		
Yes	165	88.2
<b>Complications*</b>		
No	105	56.1
<b>Death in the ICU</b>		
No	185	98.9

\*Complications included: bleeding, tamponade, acute renal injury, mechanical ventilation for more than 48 hours, arrhythmias and low cardiac output.

The mean ejection fraction was 50% ( $SD = \pm 0.1$ ). The EuroSCORE presented a mean of 5.3 points ( $SD = \pm 2.2$ ), the mean SAPS 3 was 34.2 points ( $SD = \pm 9.6$ ). The mean scores of the SOFA at 24 and 72 hours were 5.9 points ( $SD = \pm 2$ ) and 4.6 points ( $SD = \pm 2.9$ ), respectively.

As for the NAS, 187 patients were observed in the calculation at 24 hours, and 138 at 72 hours. The mean NAS in the first 24 hours was 82.4% ( $SD = \pm 3.4$ ), corresponding to 19.7

hours of workload for the nursing staff. In the NAS assessment at 72 hours, the mean value was of 58.1% ( $SD = \pm 3.4$ ) was obtained, corresponding to 13.9 hours of work for the nursing staff. In the longitudinal evaluation of the NAS, significant difference ( $p < 0.001$ ) was observed between 24 and 72 hours.

Table 2 shows that there were correlations of the NAS at 24 and 72 hours between the variable complications in the postoperative period of cardiac surgery ( $p < 0.001$ ).

**Table 2** - Bivariate analysis between the NAS at 24 and 72 hours, and the demographic variables and relative clinical development of patients after cardiac surgery - São Paulo, São Paulo, Brazil, 2014.

Variable	NAS at 24 hours				NAS at 72 hours			
	n	Mean	SD	p	n	Mean	SD	p
<b>Sex</b>				0.051*				0.208*
Male	111	82.7	3.1		75	57.8	5.4	
Female	76	81.9	3.7		63	58.4	6.1	
<b>Surgical myocardial revascularization</b>				0.258*				0.904*
No	96	82.7	3.7		69	58.1	6.7	
Yes	91	82.1	3.1		69	58.0	4.7	
<b>Valve surgery</b>				0.144*				0.646*
No	106	82.1	3.3		79	57.7	4.7	
Yes	81	82.8	3.5		59	58.6	6.9	
<b>Surgery of the aorta</b>				0.906*				0.494*
No	168	82.4	3.3		125	58.2	5.8	
Yes	19	82.5	4.3		13	56.6	5.2	
<b>Coronary bypass</b>				0.997*				0.064*
No	22	82.3	3.4		17	56.5	3.5	
Yes	165	82.4	3.4		121	58.3	5.9	
<b>Complications*</b>				<b>0.001*</b>				0.358*
No	105	81.0	3.0		80	57.5	3.6	
Yes	82	84.2	3.1		58	58.9	7.7	

\*Wilcoxon-Mann-Whitney test.

In the group of patients who had complications in the postoperative period, 35.3% developed AKI, 12.8% developed arrhythmias and 8.6% low CO. Less than 5% of cases showed bleeding (2.1%), cardiac tamponade (2.1%) and death in the period of their stay in the ICU (1.1%).

The correlation of the NAS at 24 and 72 hours with the continuous variables showed that the NAS at 24h had negative correlation of medium intensity with the SAPS 3 ( $r=-0.441$ ), and the NAS at 72 hours showed a low negative correlation with length of stay ( $r=-0.254$ ) and with the SOFA at 72 hours ( $r=-0.168$ ), as shown in Table 3.

**Table 3** - Correlation between the NAS at 24 and 72 hours, with demographic and clinical variables relative to cardiac surgery patients - São Paulo, São Paulo, Brazil, 2014.

Variable	NAS at 24h		NAS at 72h	
	r*	P	r*	P
Age	-0.024	0.749	-0.027	0.749
Body mass index	-0.019	0.796	-0.029	0.737
LVEF	-0.071	0.335	0.131	0.124
CPB time	0.102	0.163	0.099	0.250
Length of hospitalization (days)	-0.141	0.054	-0.254	<b>0.003</b>
EuroSCORE	0.024	0.748	0.066	0.445
SOFA 24 hours	0.035	0.631	-0.052	0.545
SOFA 72 hours	0.134	0.117	-0.168	<b>0.050</b>
SAPS 3	-0.441	<b>&lt;0.001</b>	0.157	0.066

r\* Spearman's correlation coefficient.

Linear regression, as demonstrated in Table 4, shows that at 24 hours the NAS is, on average, 31 points higher than at 72 hours ( $p<0.001$ ). The findings suggest that in relation to the length of stay, each day of hospitalization of the patient in the ASICU increases the NAS by a mean of 0.08 points ( $p=0.036$ ), and that the presence of complications increases the

NAS by a mean of 2.1 points ( $p<0.001$ ), regardless of hour of measurement. For the severity of the patient's condition, it was observed that each point of the SAPS 3 tended to decrease the NAS at 24 hours by 0.12 points ( $p<0.001$ ). In the case of the NAS at 72 hours, it was verified that each point of the SAPS 3 increased workload by a mean of 0.07 points ( $p=0.046$ ).

**Table 4** - Model of linear regression of the factors associated with the workload as measured by the NAS - São Paulo, São Paulo, Brazil, 2014.

Variable	Estimate	95% CI	p
Time of the NAS (24-72 hours)	31.28	(27.88-34.68)	<0.001
Length of stay	0.08	(0.005-0.162)	0.036
Complications	2.16	(0.000-1.117)	<0.001
SAPS 3 (NAS in 24 hours)	-0.12	(-0.188-0.056)	<0.001
SAPS 3 (NAS in 72 hours)	0.07	(0.001-0.152)	0.046

## DISCUSSION

Within the scope of cardiology, in the present study, the NAS obtained at 24 hours (82.4%) corresponds to 19.7 hours of work by the nursing staff per patient, a value greater in comparison to other medical specialties<sup>(7-9)</sup> and from another post-operative care unit for cardiac surgery<sup>(10)</sup>. Additionally, the NAS at 24 hours was greater than that at 72 hours.

The greater demand for care in the first 24 hours of the post-operative period can be attributed to the complexity of the clinical condition of the patient. In this study, the mean risk of mortality as estimated by the EuroSCORE, the presence of organ failure as calculated by the SOFA, and almost the entire sample submitted to CPB, were attributes that certainly led to the need for patient monitoring, in particular in the first 24 postoperative hours. In addition, the large number of therapeutic artifacts and the

complexity of intravenous therapy – including inotropic support – were aspects that may have contributed to increase the nursing workload.

On the other hand, the score of the NAS observed in ASICU was lower compared to another study conducted about ten years ago in this same care unit, in which the NAS score was 96.8%<sup>(11)</sup>. This difference of about 15 points of the NAS, which represents 3.6 hours of care, may be partly explained by the increased use of technology in InCor in the past decade.

The NAS item on monitoring and control includes, in the specific item on cardiology, hemodynamic monitoring, which, in the current context, is performed by different methods, including echocardiogram, pulmonary artery catheter and blood pressure curve analysis. In addition to this equipment are smart infusion pumps (introduced into the ICUs at InCor in the year

2000), equipment essential for patient care, especially for infusion of dose-dependent effect medications (frequently used in the first 24 hours of the postoperative period)<sup>(21)</sup>. With sophisticated alarm systems, these technologies have undoubtedly facilitated management of these critical care patients in the postoperative period, especially by the nursing staff.

The technological arsenal used in the first 24 hours in the ASICU may also help explain the reduction of the NAS with the increased severity of the patient calculated by the SAPS 3. This finding, in line with research conducted in neurological, general and cardiac ICUs of a university hospital<sup>(3)</sup>, may be the result of the positive influence of technology, which has changed the profile of nursing care provided to patients. Another aspect that may have led to this finding was the short training time of the nurses who calculated the severity scores. In the evaluation of reliability of the SAPS II score, the authors observed that nurses who received little training for the application of the scores performed overestimated or underestimated measurements<sup>(22)</sup>.

In accordance with a previous study, the increased workload in nursing was associated with the time of hospitalization of the patient<sup>(10)</sup>. This variable is clearly associated with the quality of care and the workload of the nursing staff<sup>(23-24)</sup>, in addition to representing one of the most important indicators of morbidity of patients undergoing cardiac surgery<sup>(25)</sup>.

Patients with a longer length of stay in the ICU are probably more clinically unstable and severely ill<sup>(14)</sup>, and the occurrence of complications seems to greatly contribute to time spent in the ICU. One study of patients that underwent cardiac surgery showed that the presence of complications significantly increased the time of hospitalization in the ICU<sup>(26-27)</sup>. Therefore, given the intrinsic relationship between the two variables, length of stay and presence of complications require joint interpretation.

In this study, more than one-third of the sample developed AKI (35.3%), and some (1.5%) required dialysis procedure. Cardiac complications, including arrhythmias, low CO and tamponade combined, totaled about one-fourth of the complications (23.5%), and required additional devices and therapies. In the presence of complications, increased workload is expected. The NAS items 1 – monitoring and control; 4 – hygiene procedures; 6 – mobilization and positioning; 7 – support and care to the families; and, 8 – administrative and management tasks, which enable division of the time

into hours according to the intensity of the activity (items 1, 4, 7 and 8), or by the number of nurses needed for care (item 6), illustrate the need for intensification of activities due to worsening of a patient's clinical condition.

This was one of the first studies in which the NAS was the response variable, making it possible to evaluate the influence of basal demographic and clinical variables, clinical development variables and scores of the SOFA, SAPS 3 and EuroSCORE on nursing workload in postoperative care of cardiac surgery patients. The estimate of the NAS in different types of cardiac surgery offered information about the care needs of these patients.

Regardless of the characteristics of the sample having strengthened the internal validity of the study, the generalization of the findings should be evaluated with caution. The investigation was conducted in a highly complex health care service that is a reference in the field of cardiology in Brazil and Latin America, and whose professional staff is composed of experienced nurses and physicians. Thus, the calculation of scores may have been underestimated or overestimated, depending on who was responsible for application of the instrument. Furthermore, monitoring of the sample was limited to 24 and 72 hours.

## CONCLUSION

The identification of factors associated with increased score of the NAS, which included increased length of stay in the ICU and the presence of complications, although restricted to the most frequent types of surgery in the health care service, can assist in the planning of nursing human resources in the context of postoperative cardiac surgery ICUs. In this group of critical care patients, the nursing workload represents one of the key elements that can impact human resource allocation. The fact that the SAPS 3 is a protective factor in increasing the NAS in the first 24 hours, and the lack of statistical significance between this variable and the other scores (SOFA and EuroSCORE), showed that in the present study, the severity of the patient's condition was not decisive, although this variable does frequently increase workload. In highly complex health care services (such as InCor) that rely on sophisticated technological support, especially for interventions by nursing staff, the workload in the first 24 hours tends to be lower.

## RESUMO

**Objetivo:** Identificar os fatores associados à carga de trabalho de enfermagem no cuidado a pacientes no pós-operatório de cirurgia cardíaca. **Método:** Estudo de coorte prospectivo, conduzido com 187 pacientes da Unidade de Terapia Intensiva Cirúrgica (UTI) do Instituto do Coração. Os dados foram coletados nas primeiras 24 e 72 horas do paciente na UTI. A variável dependente foi a carga de trabalho calculada por meio do *Nursing Activities Score* (NAS) e as independentes foram de natureza demográfico-clínicas e escores de morbimortalidade. Para análise dos dados utilizou-se os testes de Wilcoxon-Mann-Whitney e de correlação de Spearman, e a regressão linear com modelo de efeitos mistos. **Resultados:** A maioria dos pacientes era do sexo masculino (59,4%), com média de idade de 61 anos ( $\pm 12,7$ ) e 43,9% desenvolveram algum tipo de complicação no pós-operatório. Nas 24 horas, a carga de trabalho foi de 82,4% ( $\pm 3,4$ ) e foi de 58,1% ( $\pm 3,4$ ) nas 72 horas. Os fatores associados ao aumento do NAS foram: tempo de internação do paciente na UTI ( $p=0,036$ ) e a presença de complicações ( $p<0,001$ ). **Conclusão:** A gravidade do paciente nas 24 horas, em oposição a inúmeros estudos, não influenciou no aumento da carga de trabalho, a qual se mostrou associada ao tempo de internação e às complicações.

## DESCRIPTORIOS

Cuidados de Enfermagem; Carga de Trabalho; Procedimentos Cirúrgicos Cardíacos; Escores de Disfunção Orgânica; Enfermagem Perioperatória; Unidades de Terapia Intensiva.

**RESUMEN**

**Objetivo:** Identificar los factores asociados con la carga de trabajo de enfermería en el cuidado de los pacientes después de la cirugía cardíaca. **Método:** Estudio prospectivo de cohorte, realizado con 187 pacientes de la Unidad Quirúrgica de Cuidados Intensivos (UCI) del Instituto do Coração. Los datos fueron recogidos en las primeras 24 y 72 horas el paciente en la UCI. La variable dependiente fue la carga de trabajo calculada por el Nursing Activities Score (NAS) y eran independientes de la naturaleza y de mortalidad puntajes demográficos y clínicos. Para el análisis de los datos se utilizó la prueba de Wilcoxon-Mann-Whitney y Spearman correlación y de regresión lineal con el modelo de efectos mixtos. **Resultados:** La mayoría de los pacientes eran varones (59,4%) con una edad media de 61 años ( $\pm 12,7$ ) y 43,9% desarrollaron algún tipo de complicación en el postoperatorio. Dentro de 24 horas, la carga de trabajo fue 82,4% ( $\pm 3,4$ ) y 58,1% ( $\pm 3,4$ ) en 72 horas. Los factores asociados con el aumento de NAS fueron: longitud del paciente de la estancia en la UCI ( $p=0,036$ ) y la presencia de complicaciones ( $p<0,001$ ). **Conclusión:** La gravedad de la paciente dentro de 24 horas, a diferencia de numerosos estudios, no afectó a la mayor carga de trabajo, que se asoció a la duración de la estancia y complicaciones.

**DESCRIPTORES**

Atención de Enfermería; Carga de Trabajo; Procedimientos Quirúrgicos Cardíacos; Puntuaciones en la Disfunción de Órganos; Enfermería Perioperatoria; Unidades de Cuidados Intensivos.

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