



Nursing activities score: a comparative study about retrospective and prospective applications in intensive care units*

Nursing activities score: estudo comparativo da aplicação retrospectiva e prospectiva em unidade de terapia intensiva

Nursing activities score: estudio comparativo de la aplicación retrospectiva y prospectiva en una unidad de cuidados intensivos

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ABSTRACT

Objectives: To analyze the performance of the Nursing Activities Score (NAS) to measure the prospective nursing workload in Intensive Care Units (ICU) and to compare the NAS values obtained in prospective and retrospective applications of the instrument, in addition to verifying the degree of concordance in the items that comprise it applied prospectively and retrospectively. **Methods:** NAS was applied prospectively and retrospectively. Student's t, Pearson's coefficient and Intra-class correlation (ICC) were used to verify correlation and homogeneity. For agreement between each item, the Kappa coefficient was used. **Results:** There were differences ($p < 0.001$) between the prospective and retrospective NAS averages (Pearson 0.65 and ICC 0.623). Kappa was not applied to 11 items due to the high percentage of agreement in a single response category. Ten items (47.6%) had agreements equal or higher than moderate. Items with very strong and strong agreement refer to objective data that usually do not present disagreements. Items with sub-items had lower agreements. **Conclusions:** Prospective NAS performed well in measuring nursing workload at the ICU.

Keywords: Intensive care units/manpower; Intensive care units/statistics & numerical data; Workload /statistics & numerical data; Nursing care/statistics & numerical data

RESUMO

Objetivos: Analisar o desempenho do Nursing Activities Score (NAS) para a medida prospectiva de carga de trabalho de enfermagem em Unidade de Terapia Intensiva (UTI) e comparar os valores do NAS obtidos na aplicação prospectiva e retrospectiva do instrumento, além de verificar o grau de concordância nos itens que o compõem aplicados na forma prospectiva e retrospectiva. **Métodos:** O NAS foi aplicado prospectiva e retrospectivamente. Para verificar a correlação e homogeneidade utilizou-se o t-student, Coeficiente de Pearson e Correlação Intraclasse (ICC). Para a concordância entre cada item utilizou-se o Kappa. **Resultados:** Houve diferença ($p < 0,001$) entre as médias do NAS prospectivo e retrospectivo (Pearson 0,65 e ICC 0,623). Em 11 itens não foi aplicado o Kappa devido a elevada porcentagem de concordância em uma única categoria de resposta. Dez itens (47,6%) apresentaram concordância igual ou maior do que moderada. Itens com concordância muito forte e forte referiram-se a dados objetivos que geralmente não apresentam discordâncias. Já os itens com sub-itens apresentaram concordâncias mais fracas. **Conclusões:** O NAS prospectivo apresentou bom desempenho para a medida de carga de trabalho de enfermagem na UTI.

Descritores: Unidades de terapia intensiva/recursos humanos; Unidades de terapia intensiva/ estatística & dados numéricos; Carga de trabalho/estatística & dados numéricos; Cuidados de enfermagem/estatística & dados numéricos

RESUMEN

Objetivos: Analizar el desempeño del Nursing Activities Score (NAS) para la medida prospectiva de la carga de trabajo de enfermería en una Unidad de Cuidados Intensivos (UCI) y comparar los valores del NAS obtenidos en la aplicación prospectiva y retrospectiva del instrumento, además de verificar el grado de concordancia en los items que lo componen aplicados en la forma prospectiva y retrospectiva. **Métodos:** El NAS fue aplicado prospectiva y retrospectivamente. Para verificar la correlación y homogeneidad se utilizó el t-student, Coeficiente de Pearson y Correlación Intraclase (ICC). Para la concordancia entre cada ítem se utilizó el Kappa. **Resultados:** Hubo diferencia ($p < 0,001$) entre los promedios del NAS prospectivo y retrospectivo (Pearson 0,65 e ICC 0,623). En 11 ítems no fue aplicado el Kappa debido al elevado porcentaje de concordancia en una única categoría de respuesta. Diez ítems (47,6%) presentaron concordancia igual o mayor que la moderada. Ítems con concordancia muy fuerte y fuerte se refirieron a datos objetivos que generalmente no presentan discordancias. Ya los ítems con sub-ítems presentaron concordancias más débiles. **Conclusiones:** El NAS prospectivo presentó buen desempeño para la medida de carga de trabajo de enfermería en la UCI.

Descritores: Unidades de terapia intensiva/recursos humanos; Unidades de terapia intensiva/ estadística & datos numéricos; Carga de trabajo/ estadística & datos numéricos; Cuidados de enfermería/ estadística & datos numéricos

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INTRODUCTION

Using tools to measure the nursing workload in Intensive Care Units is useful when one needs to discuss the lack of nursing professionals capable of providing quality care to each patient's needs; as a response to increasing numbers of specialized professionals working in intensive care units; to identify the influence of technological changes, and also to direct professional improvements in care towards critical patients.

The Nursing Activities Score (NAS)⁽¹⁾ was developed with the purpose of responding to these questions. Its relevance stems from the fact that it is a workload measurement tool, which includes, besides direct care activities, relevant activities at the ICU such as support for family members, developing managerial activities, among others.

The index is made up of seven large categories: basic activities, ventilatory, cardiovascular, renal, neurologic, metabolic support and specific interventions.

The basic activities category is divided in eight subcategories: Monitoring and control, Laboratorial investigations, Medication, Hygiene procedures, Drain handling, Mobilization and placement of the patient, Support and care for family members and patients, and Managerial tasks, with subcategories 1, 4, 7 and 8 having sub-items.

As a whole, the index scores the time spent by the nursing team to perform 23 therapeutic and nursing procedures. The items that compose the index are filled out according with the registry of the nursing activities performed in the last 24 hours of ICU hospitalization. This provides retrospective information about the nursing workload.

As a result, the total NAS score represented the percentage of time spent by the nursing professionals in direct care for patients, which can reach up to 176.8%.

Even with the advantages presented, NAS became vulnerable to criticism, among them the fact that it uses retrospective data, which consequently bases it on care routines performed that may not correspond to the care required by the patients. As such, although the retrospective application of NAS is useful as a managerial tool, the limitation imposed by this form of application makes it difficult to distribute the nursing professionals per patient per shift, a relevant aspect to perform the care that the patient effectively demands.

This data is highly necessary in daily ICU practice, because the use of the score obtained retrospectively does not reflect the nursing workload considered necessary to meet the demands for care in the subsequent hours.

Therefore, this investigation was formulated, due to the possibilities of optimization for prospective NAS and its importance as a nursing workload measurement tool,

as well as its capability of indicating the nursing staff per patient ratio, per shift, based on the real care demands.

OBJECTIVE

This study aimed at analyzing the performance of NAS to measure the ICU nursing workload prospectively, and comparing the NAS values obtained in the prospective and retrospective applications of the tool, in addition to verifying the degree of agreement among the items that make it up, applied prospectively and retrospectively.

METHODS

This is a methodological development study performed in a general adult ICU, part of a private tertiary-level hospital in the city of São Paulo. The research project was approved by the Review Board of Escola de Enfermagem at Universidade de São Paulo, and later by the study field hospital.

Casuistics

The sample consisted of 104 patients, over the age of 18 years, who were hospitalized at the ICU for at least 24 hours (from 7 AM to 7 AM), counted after their admission at the unit.

Patients admitted after 7 AM of the day selected for data collection were excluded, and those who either died or were discharged, since they did not complete the full 24-hour stay at the ICU. Patients with heart conditions were also excluded to calculate the Simplified Acute Physiology System II (SAPSII), since they did not fit the application criteria of this index⁽²⁾.

Collection procedure

Data collection occurred from September to November/2006, by the researcher and a monitoring nurse trained for data collection.

For this study, the researcher collected demographic, clinical and hospitalization data, SAPS II, Logistic Organ Dysfunction System (LODS) and the prospective and retrospective NAS. Prior to the start of data collection, a pre-test was performed to compare data registries, performed by the researcher and the monitoring nurse, with the purpose of standardizing the procedures and avoiding biasing the data collection. The investigation data were only collected after both evaluators fully understood each item of the tool.

For data collection itself, a random day of the week was selected, according to the researcher's availability.

In the previously-established days, the monitoring nurse went to the hospital at 7 AM in order to select the patients and start data collection.

At this stage, the monitoring nurse evaluated the patients, identified their healthcare needs and planned the nursing activities that should be performed, so that each of them could have their specific necessities seen to by 7 PM.

Later, she filled out the NAS tool prospectively, based on the clinical evaluation performed. Whenever necessary, she complemented the evaluation by consulting the activities programmed in the nursing prescription, written by the nurse at the unit during that shift.

Filling out items 7 – support and care for family members and patients and 8 – managerial tasks, was done according with information conveyed by the nurses working at the unit. If there were doubts about the scores of these items, the lowest value was considered.

At 7 PM of the day, the researching nurse would proceed with the prediction of the activities that should be performed in the following 12 hours, i.e., until 7 AM of the next day, according to the same procedures performed by the monitoring nurse, previously described.

The next day, the researcher would return to the unit to check the medical records and fill out the NAS tool retrospectively. For that, she took into account the information present in the notes, nursing evolution and prescription (checked items), medical report and prescription and the datasheet with the results of laboratory exams.

To fill the NAS items 1, 4, 7 and 8, the nurses at the unit, responsible for the beds, were asked by the researcher or by the monitoring nurse about the time spent in the performance of each activity, according to the normalcy standard of the unit. This time was evaluated subjectively by the professionals as normal, above normal and much above normal.

Data analysis

Data analysis was done through descriptive and inferential statistics, with the help of a specialized professional. A 5% significance level was considered for all analyses.

Wilcoxon's non-parametric test was used for the pilot stage of the test.

Agreement between the measurements of each item in the tool, evaluated individually by the collectors, was performed with the Kappa index. Reference values adapted from literature were used to interpret the data obtained with that index⁽³⁾.

When it was impossible to apply the Kappa, i.e., when certain items of the NAS tool had only one answer category, a complementary approach was performed, verifying the percentage of equal answers in both measurements (by the researcher and by the monitoring nurse).

Similar analyses to that in the pilot test were performed

to meet the study goals. Student's t test was used for paired samples with the purpose of comparing the average NAS between both evaluations (prospective and retrospective).

Pearson's coefficient was used to verify whether there was a linear correlation between the NAS measured retrospectively and prospectively. The Intra-class correlation coefficient was also calculated to evaluate homogeneity (or agreement) between both quantitative measurements.

Similar to the pilot test, the Kappa index was used to evaluate the level of agreement between each NAS item, measured prospectively and retrospectively.

RESULTS

Regarding the pilot test, the total NAS score comparison between the data obtained by the researcher nurse and the monitoring nurse showed that there were no significant differences in the average NAS score between both evaluators ($p = 0.498$).

For the comparison between each NAS item, according to the collectors' evaluation, it was observed that out of 32 items of the tool, most (23 – 71.8%) had an expressive degree of agreement. It was also observed that 19 out of the 32 items where the Kappa index was applied presented values between 0.80 and 1.00, indicating a very strong agreement in for such items. Items 1a, 4a and 4b presented strong agreement, with the Kappa index between 0.60 and 0.79. Only item 1b showed a moderate agreement, with a Kappa index between 0.40 and 0.59.

As for the items where the Kappa index and p-value could not be calculated, the percentile agreement analysis also showed 100% values for all items.

It should be noted that the divergences found in the collections were solved with the discussion and standardization of data collection between the collectors. After these procedures, it was concluded that both evaluators had the same understanding about filling out the NAS items.

About the patients' demographic, clinical and hospitalization data, the average age was 65.8 years (SD: 20.7, ranging from 20 to 97 years). Most patients were male (55.8%) and had systemic hypertension as the predominant pre-existent chronic disease (45.2%).

Hospitalizations due to clinical reasons prevailed (76.0%), with the main reasons for ICU admittance being consequences of problems in the nervous and respiratory systems (30.8% and 29.8%, respectively). A large share of the hospitalizations had patients coming from the emergency service (35.6%), followed by surgical center (26.0%) and inpatient units (18.3%). In 11.5% of the cases, the patients were admitted into the ICU from other services or from their homes.

The ICU death rate was 17.3%.

The studied sample had patients aged 65.8 years on average (SD: 20.7, ranging from 20 to 97 years), and average ICU hospitalization time of 12.7 days (SD: 10.9, ranging from 1 to 58 days). About the gravity, an average SAPS II score of 31.8 points was observed, and mortality risk (MR) or expected mortality of 19.1%. According to LODS, the death rate was 14.3%.

Table 1 shows the scores related to the prospective and retrospective application of NAS.

NAS values obtained retrospectively and prospectively had a moderate linear correlation (Pearson 0.65). Similarly, it can be observed that the retrospective measures were homogenous (ICC 0.623), according to the Intra-class correlation coefficient (ICC).

The level of agreement between each NAS item, according to the prospective and retrospective evaluations is presented in Table 2.

According to the data on Table 2, it was verified that out of 21 NAS items where the Kappa index was applied, five had very strong agreement (5. drain monitoring, 10. artificial airway monitoring, 12. vasoactive medication, 14. left atrium monitoring, 20. total parenteral nutrition), while four others had strong concordance (9. respiratory support, 17. quantitative measurement of urinary debt, 18. intracranial pressure measurement and 21. enteric feeding through tubing). Only one item had moderate agreement (1a. vital signs, calculation and registration of hydric balance).

Among the lower agreements, six items were observed to have low agreements (1c. bedside presence for four hours or longer, 6a. mobilization and placement up to three times in a 24h-period, 6b. mobilization and placement more than three times in a 24h-period, 11. treatment to improve pulmonary function, 16. blood filtering techniques and 23. specific interventions outside the ICU), three items with very low agreement (1c. bedside presence for two hours or longer, 4a. performing hygiene procedures and 22. specific interventions at the ICU), and two items (4b. performing hygiene procedures lasting over two hours and 19. acidosis/alkalosis treatment) showed no agreement at all among the items evaluated prospectively and retrospectively.

The 11 remaining items could not be evaluated with the Kappa index because they had the same response category in both moments of application of the tool.

Table 2 – Degree of agreement of each NAS item, according to the prospective and retrospective application of the tool. São Paulo, 2006

Item	Degree of agreement (%)	Kappa	p-value
1a	78.9	0.462	< 0.001
1b	77.0	0.194	0.047
1c	88.5	0.300	< 0.001
2	100.0	***	***
3	100.0	***	***
4a	77.9	0.026	0.786
4b	77.9	- 0.044	0.653
4c	97.1	***	***
5	96.2	0.888	< 0.001
6a	79.9	0.342	< 0.001
6b	77.9	0.348	< 0.001
6c	94.2	***	***
7a	99.0	***	***
7b	99.0	***	***
8a	98.1	***	***
8b	98.1	***	***
8c	100.0	***	***
9	91.3	0.746	< 0.001
10	97.2	0.937	< 0.001
11	62.5	0.342	< 0.001
12	96.2	0.898	< 0.001
13	90.4	***	***
14	100.0	1.000	< 0.001
15	100.0	***	***
16	94.2	0.381	< 0.001
17	92.3	0.689	< 0.001
18	99.0	0.795	< 0.001
19	91.3	- 0.031	0.701
20	97.1	0.808	< 0.001
21	90.4	0.798	< 0.001
22	80.7	0.088	0.285
23	80.8	0.349	< 0.001

*** category with a different answer or a single category

DISCUSSION

The results found in this study about the predominance of male patients, with a high average age are in agreement with the statistics of the Ministry of Health, which point to increasing numbers of elderly people in all state capitals over the years⁽⁴⁾.

Table 1 – Distribution of the averages, medians, standard deviations, minimum and maximum NAS values according to the prospective and retrospective application of the tool. São Paulo, 2006.

NAS	n	Average	Median	Standard deviation	Minimum	Maximum
Prospective	104	59.8	58.6	12.1	34.1	94.4
Retrospective	104	52.7	52.1	9.2	32.2	75.2

*Student's t

Concomitantly with population aging, the number of people with chronic-degenerative diseases also increased, triggering health aggravations with the consequent need of interventions that require hospitalization at an ICU.

Therefore, most patients in this sample were mainly expected to be hospitalized due to clinical reasons (76.0%). There is no consensus in literature about the type of hospitalization for patients that receive care in general ICUs⁽⁵⁻⁸⁾.

As for the prevalence of hospitalization of patients coming from emergency services, the data allow us to infer that the patients, for being at an advanced age and having chronic-degenerative diseases, were admitted into the emergency service with grave instabilities, needing intensive care therefore.

In this study, long average hospital stays (12.7 days) were observed, different from findings of other studies^(5,7-11), with average lengths between 2 and 7.2 days, showing that this specific population needs intensive care for longer periods.

Regarding the conditions to leave the ICU, a death rate of 17.3% was observed in the studied sample, which is compatible with Brazilian studies that presented a variation from 17.5% to 20.6%^(5,12-13) and foreign studies oscillating between 11.3% and 16.1%⁽⁸⁻⁹⁾. The death rate observed was lower than expected by SAPS II and LODS (19.1% and 14.3%, respectively), an indicator that shows high quality standards for the services provided by the ICU studied.

Considering that both evaluators had the same understanding about the many items of the tool, the statistically significant difference found among the average NAS values obtained by prospective and retrospective evaluations (Table 1), with higher scores found in the prospective application of the tool, leads to some assumptions:

The NAS score, as originally proposed, is based on information about the last 24 hours of the hospital stay, registered in the medical records, therefore being retrospective. Failure to register such information or even routines imposed by the institution (e.g. recording vital signs 2/2h, regardless of the gravity of the patient) could have led to a lower NAS, when measured this way.

Previously scheduled nursing activities or medical procedures may not have been performed by several reasons, thus not consuming the time predicted in the prospective assessment, resulting in higher scores thereof.

In spite of these assumptions, the higher NAS average score for the prospective application shows that the individual assessment of the patient, in real time, with care designed for the subsequent hours of the day, yields results that are more faithful when one intends to measure the nursing workload at the ICU.

Considering the moderate correlation and

homogeneity observed among the NAS averages obtained in the prospective and retrospective applications (Pearson 0.65; ICC 0.62), it is considered that both forms of this index are valid when one intends to measure the nursing workload at the ICU.

However, prospective NAS has advantages over the retrospective version, since it always considers the schedule of the nursing activities to be performed in each patient in a given period. This, in turn, results in the nursing workload. In the daily intensive care practice, this data is relevant for the nurses, because the nursing professionals are distributed at the beginning of each working shift, considering this schedule. Besides, the prospective application is done with the goal of providing full care for the patients, according to their necessities, exempt from interferences related to the organizational structure of the institution that may hinder care as it should be performed.

Results about the agreement of each NAS item, according to the prospective and retrospective evaluations also reiterate the good performance of the prospective NAS.

It was observed that the Kappa index could not be applied in 11 out of the 32 items of the tool, due to a high percentage of agreement in a single category of responses. On the other hand, in the 21 items where the analysis was possible, 10 (47.6%) had agreements equal or higher than moderate, with only one item being found at that rating (item 1a).

Focusing particularly on the agreement per item, the results for those with very strong (items 5, 10, 12, 14, 20) and strong agreement (items 9, 17, 18 and 21) were already expected, since they refer to more objective and punctual data, easy to evaluate and monitor by the nursing professionals, and which usually do not present disagreements about the type of care to be provided.

Likewise, items subdivided in sub-items (a, b and c) were those subjected to lower agreements, either due to subjective changes of the collectors and nurses at the unit, or due to the absence of records that could provide reliable information. The observation that sub-items 1b, 1c, 4a, 6a and 6b are among those with low and very low agreements reiterates this statement.

The remaining items with low and very low agreement, i.e., 10 (treatment for improving lung function), 16 (dialytic techniques), 22 and 23 (therapeutic interventions at the ICU and outside it) are included among the nursing, physical therapy activities or medical procedures, previously programmed and subject to not being performed by other reasons.

About the items where the Kappa index was not applied because there was only one response category, the findings are justified in items 2 (laboratory investigations) and 3 (medication), since these activities are

performed daily at the ICU, therefore not casting doubts about their scores. Likewise, since item 13 (intravenous repositioning of large losses of fluid) is an activity that depends on medical prescription and evaluation, but possible to be predicted by the nursing team, similar scores were expected in both evaluations. The same can be said of item 15 (cardiorespiratory resuscitation), since this item is difficult to predict, and, by coincidence, did not occur in the sample of the present study.

The fact that items 4c, 6c, 7a, 7b, 8a and 8b also presented a single response category is justified by being items with mutually excluding subdivisions, and that were considered in only one of the sub-items.

These findings justify the prospective application of NAS, since the predictions made by the collectors were based on the necessities presented by the patients and were not contaminated by the routines imposed by the unit.

It is concluded, therefore, that the prospective NAS can be used when one intends to lay out the nursing care to be provided, especially when one intends to distribute the nursing professionals needed to provide quality assistance during a working shift. However, there is the need of an effective uniformity among the ICU nurses, so that this prediction can be reliable and the workload can be adequately measured.

In spite of these results, some study limitations deserve an analysis before the definitive application of the prospective NAS. Since this is the first and only study focused specifically on the application of NAS in a different way than its original proposition, other investigations should be performed to validate or reject the results obtained. Besides, the utilization of the Kappa index as the only statistical tool for the analysis of

agreement between the items must be considered. Different authors⁽¹⁴⁻¹⁶⁾ have identified restrictions to its usage to evaluate the degree of agreement. Besides, other tests are available for this goal and will be used in future investigations.

Another limitation is the lack of systematically using this instrument at the ICU where the study was developed for the retrospective NAS measurement, which might have contributed for the retrospective NAS, and even the prospective NAS to be underestimated, especially because of the lack of records for categories with sub-items.

Despite its limitations, it is believed that the prospective application of NAS should be encouraged, with the purpose of obtaining better information about its performance and adequate the distribution of the nursing staff for the daily practice at the ICU, based on the necessities of care demanded by the patients. However, the utilization of the manual of the instrument⁽¹⁷⁾ is highly recommended to maintain the uniformity of information, as well as training the professionals. Only reliable information will be capable of leading to an adequate nursing professional/patient ratio at the ICU and properly subsidizing the general dimensioning of staff at the unit.

CONCLUSIONS

According to the analysis of the data in this investigation, it can be concluded that the prospective NAS had a good performance for the measurement of nursing workload at the ICU, with its application for the distribution of the nursing professionals being possible during a working shift, based on the patients' necessities for care.

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