



ELSEVIER

ORIGINAL ARTICLE

ICCN

www.elsevierhealth.com/journals/iccn

Nursing workload in intensive care units: A study using the Therapeutic Intervention Scoring System-28 (TISS-28)

Katia Grillo Padilha^{a,*}, Regina M. Cardoso Sousa^a, Miako Kimura^a,
Ana Maria Kazue Miyadahira^a, Diná Almeida Lopes Monteiro da Cruz^a,
Maria de Fátima Vattimo^a, Solange Regina Giglioli Fusco^b,
Maria Emília Ferraz de Campos^b, Edoíla Maria Teixeira Mendes^b,
Eliana Rodrigues Carlessi Mayor^b

^a School of Nursing, University of São Paulo, Av. Dr. Eneas de Carvalho Aguiar,
419, CEP 05403-000, São Paulo, SP, Brazil

^b Hospital of Clinics, University of São Paulo, São Paulo, Brazil

Accepted 18 July 2006

KEYWORDS

Intensive care units;
Critical care;
Nursing workload;
Indicators of health
services

Summary The Therapeutic Intervention Scoring System-28 (TISS-28) is an instrument that has been used to measure severity of illness and nursing workload in intensive care units (ICUs).

Objectives: To characterize the severity of illness and nursing workload using the TISS-28 in 11 ICUs of a university hospital in the city of São Paulo, Brazil.

Methods: In a prospective study, data were collected from 271 patients admitted to the ICUs in December 2000 and the patients were followed up for 1 week.

Results and conclusions: Most of the patients were males (60.0%) and their mean age was 51(+20.6) years. Surgical treatment (66.8%) and admissions from the operating room were predominant. The mortality rate was 25.0% and the average length of stay was 7.7 (+10.4) days. The mean TISS-28 score was 23 (range: 14–32 points). The lowest mean score was observed for patients from the Burn ICU and the highest mean score was obtained for patients from the Liver Transplant ICU. A change in TISS-28 scores was observed in the same ICU over the 7-day study period. Units differed in terms of severity of illness and nursing workload. Patients who died received a higher TISS-28 score than patients who survived ($p=0.00$). As the nursing staff

* Corresponding author. Tel.: +55 11 3066 7544; fax: +55 11 3066 7546.

E-mail addresses: kgpadilh@usp.br (K.G. Padilha), vian@usp.br (R.M.C. Sousa), mikimura@usp.br (M. Kimura), seizom@usp.br (A.M.K. Miyadahira), mtmlf@usp.br (D.A.L.M. da Cruz), nephron@usp.br (M.d.F. Vattimo).

URL: <http://www.utd.div.enf.@hcnet.usp.br> (S.R.G. Fusco).

are the largest economic investment in an ICU, so measuring nursing workload in different ICUs from different centres can contribute to the estimation of nursing staff required according to the specific demands of the units.

© 2006 Elsevier Ltd. All rights reserved.

Introduction

The increasing costs of treatments in intensive care units (ICU) and the need to use its resources with efficiency are reasons to define patients who require admission to an ICU. Severity of illness assessment is a relevant component to the management of cost effectiveness of ICU. As important as it is to determine illness severity the assessment of nursing workload is also relevant to ICU cost-effectiveness.

The Therapeutic Intervention Scoring System-28 (TISS-28) has been found to be a useful tool. In addition to showing a good correlation with the severity of illness, it is an indicator of nursing workload in the ICU. The TISS was developed as an instrument that classifies patients according to severity of illness. It is based on the principle that the number of therapeutic interventions is related to the severity of the clinical conditions. The more severe the state of the patient, the larger the number of therapeutic interventions necessary for treatment and, consequently, the higher the TISS-28 score, the longer the nursing time spent on such care (Miranda et al., 1996).

The TISS, originally developed in 1974 (Cullen et al., 1974), was modified in 1983 (Keene and Cullen, 1983) and in 1996 when it was given the name TISS-28 (Miranda et al., 1996). The TISS-28 was developed from a large database of TISS-76 by Miranda et al. (1996). Items from 76 to 28 were minimized by content analysis (clinical relevance, redundancy and frequency) and component principal analysis. Weights were attributed to the 28 items using TISS-76 score per record as the predicted score value. The scores from the TISS 76 items were compared with those from the TISS 28 items, producing a high correlation coefficient ($r=0.96$). The "work sampling" method was used to estimate time required for each TISS-28 point (Miranda et al., 1996). During a 1-week period, all the nurses on duty scored their activities in selected moments of the 24 h our period. The "work sampling" generated 10,079 records of nursing activities of which 5530 were matched with TISS-28 records. The association between the TISS score and the distribution of time among the full range of nursing activities showed that one TISS-28 point corresponds to 10.6 min of nursing time spent

on direct patient care, thus permitting the estimation of nursing workload in an ICU (Miranda et al., 1996).

This version consists of seven large groups or domains which together correspond to the treatment of patients with severe conditions, i.e. basic activities, ventilatory, cardiovascular, renal, neurological and metabolic support and specific interventions. The TISS-28 score ranges from 1 to 78 points.

In view of the availability of a worldwide known instrument which, by permitting the scoring of therapeutic interventions also permits an indirect evaluation of the severity of illness and an estimate of nursing workload, the objective of the present study was to characterise the profile of patients and nursing workload in the different ICUs of a tertiary university hospital in the city of São Paulo, Brazil, using the TISS-28.

Methods

The study was conducted at the main university of the largest health care referral center in Brazil and Latin America. It is a governmental tertiary general hospital. In 2000, the hospital provided 948 active beds, with 109 (11.5%) intensive care beds distributed among 11 Medical and Surgical ICUs. The units and respective number of beds are shown below.

• Internal Medicine ICU	11 beds
• Surgery ICU	20 beds
• Medical Emergency ICU	11 beds
• Trauma ICU	10 beds
• Neurology ICU	11 beds
• Liver Transplantation ICU	5 beds
• Hematology ICU	2 beds
• Infectious diseases ICU	6 beds
• Nephrology ICU	6 beds
• Burn ICU	4 beds
• Surgical Support ICU	23 beds

The study sample consisted of patients consecutively admitted to the ICUs between December 1 and 31, 2000, regardless of age and type of treatment, who remained hospitalised in the ICU for a minimum period of 24 hours.

For data collection, a chart containing demographic and clinical data of the patient and the daily TISS-28 score was used. A data collection

chart was assigned to each patient and used to record the daily therapeutic interventions received by the patients over the last 24 h of ICU hospitalisation. For standardisation, this period was always started at 8 a.m. The TISS-28 was filled out prospectively on the basis of the data present on the charts of the patients. The TISS-28 was applied daily for 7 days except in cases of earlier patient ICU exit for any reason.

After approval of the study by the Research Ethics Committee of the hospital, two courses about the application of the TISS-28 were initially administered, one to the intensive care nurses of the hospital and another to undergraduate nursing students who participated in the data collection. The main objective of the courses was to standardise concepts about the instrument and to provide training to all participants.

The data were analysed using the SPSS 13.0 software. Data referring to all patients from all ICUs and from each ICU were submitted to descriptive analysis. The parametric *t*-test was applied to verify the differences of mean TISS-28 scores between patients who died and those who were discharged from ICU. An alpha level of 0.05 was used for all statistical tests.

Results

During the period from December 1 to 31, 2000, a total of 286 patients were admitted to the 11 ICUs but just 271 remained there 24h or longer. The distribution of these patients per unit is shown in Fig. 1. During the study period, a higher percentage of patients were admitted to the Surgery Support, Neurology and Surgery ICUs (21.8, 18.8 and 17.3%, respectively), corresponding to 57.9% of the sample. These were followed by the Medical Emergency and Internal Medicine ICUs which, together, admitted 18.4% of the patients, whereas

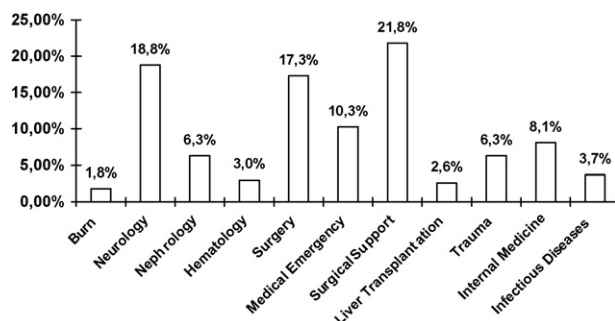


Figure 1 Distribution of patients ($n = 271$) according to ICU. São Paulo, 2000.

the remaining units (Trauma, Nephrology, Infectious Diseases, Liver Transplantation, Hematology and Burn ICUs) admitted 23.7% of the patients.

Considering the Internal Medicine, Medical Emergency, Hematology and Infectious Diseases ICUs as providing predominantly medical care, the 30 beds (27.5% of total ICU beds) of these units attended about 25.1% of the sample. In contrast, the surgical units, which comprise 79 beds (72.5% of total ICU beds), provided services for 74.9% of the sample.

Characterization of the patients and nursing workload in the ICUs

As shown in Table 1, 60.0% of the patients were males. With respect to age, 38.1% of the patients were 61 years or older, whereas about 30.0% of the population ranged in age from 41 to 60 years. The mean age of the study population was 51 ± 20.6 years.

Regarding the type of treatment, most patients (66.8%) were submitted to surgical treatment. Among all patients analyzed, 45.5% were referred from the operating room, 25.7% from the emer-

Table 1 Sample characteristics

Variable	No.	(%)
Gender ($n = 271$)		
Male	162	60.0
Female	109	40.0
Age (years) ($n = 266$) ^a		
<20	19	7.0
$\geq 21 < 41$	68	25.6
$\geq 41 < 61$	78	29.3
$\geq 61 < 81$	84	31.6
≥ 81	17	6.5
Type of treatment ($n = 265$) ^a		
Surgical	177	66.8
Medical	88	33.2
Origin ($n = 253$) ^a		
Operating room	115	45.5
Emergency room	65	25.7
Wards	38	15.0
Others	35	13.8
LOS (days) ($n = 271$)		
<5	153	56.5
$\geq 5 < 10$	57	21.0
$\geq 10 < 15$	29	10.7
≥ 15	32	11.8
Exit condition ($n = 271$)		
Survival	202	75.0
Death	69	25.0

São Paulo, 2000.

^a Missing data.

Table 2 Mean (\pm S.D.) LOS, Age, mean TISS-28 and mortality rate obtained for each ICU

ICU	N	LOS (days)	N ^a	Age (years)	N ^b	TISS-28	N	Mortality (%)
Liver Transplantation	07	11 (\pm 14.8)	07	44(\pm 20.1)	07	32(\pm 8.5)	07	42.8
Trauma	17	11 (\pm 7.9)	17	43 (\pm 29.1)	15	28(\pm 6.3)	17	35.2
Hematology	08	5 (\pm 1.9)	7	48 (\pm 14.5)	07	26(\pm 8.5)	08	87.5
Nephrology	17	7 (\pm 9.6)	17	43 (\pm 21.8)	13	25(\pm 8.8)	17	41.1
Internal Medicine	22	10 (\pm 6.6)	20	57 (\pm 18.1)	16	25(\pm 5.8)	22	45.4
Medical Emergency	28	12 (\pm 14.0)	28	58 (\pm 22.1)	26	23(\pm 8.9)	28	42.8
Surgery	47	6 (\pm 7.2)	47	58 (\pm 17.6)	45	22(\pm 7.2)	47	19.1
Neurology	51	9 (\pm 14.8)	49	42 (\pm 18.7)	42	22(\pm 4.4)	51	9.8
Surgical Support	59	4 (\pm 1.4)	59	56 (\pm 18.9)	59	21(\pm 6.5)	59	11.8
Infectious Diseases	10	9 (\pm 6.9)	10	39 (\pm 14.8)	08	18(\pm 4.6)	10	20.0
Burn	05	17 (\pm 11.6)	05	44 (\pm 7.7)	04	14(\pm 2.5)	—	—
Total	271		266		242		271	
Overall mean		7.7 (\pm 10.4)		51(\pm 20.6)		23 (\pm 7.2)		25.0

São Paulo, 2000.

^a Patients included in the calculation of mean and S.D. age (missing data = 5).^b Patients included in the calculation of mean and S.D. TISS-28 score (missing data = 31).

gency room and 15.0% from the medical–surgical wards. In addition, 13.8% of the patients were admitted from other ICUs of the same hospital or from other hospitals.

With respect to length of ICU stay, 56.5% of the patients were hospitalised for up to 4 days, whereas 22.5% stayed for a period of 10 days or longer. Twenty-one percent of the patients stayed on the ICUs for 5–9 days. The average overall length of stay (LOS) was 7.7 ± 10.4 days. The mortality rate of 271 patients was 25.0%.

In order to characterise each ICU separately, the following variables were analysed: age, length of stay (LOS), exit conditions and TISS-28 score (Table 2). Mean age ranged from 42 to 48 years in 54.6% of the ICUs, including the Neurology, Nephrology, Trauma, Liver Transplantation, Burn and Hematology units. A higher mean age in the 56–58 year range was observed for 36.4% of the ICUs, including the Surgery Support, Surgery, Internal Medicine and Medical Emergency units. The lowest mean age of 39 years was observed for the Infectious Diseases ICU.

The mean LOS ranged from 5 to 9 days in 5 (45.5%) of the 11 ICUs (Hematology, Surgery, Nephrology, Neurology and Infectious Diseases units). A mean LOS of 10 days or longer was also observed in five units (45.5%) (Internal Medicine, Liver Transplantation, Trauma, Medical Emergency and Burn units). Only the Surgical Support unit showed a mean LOS of 4 days.

The highest mortality rate (87.5%) was observed for the Hematology ICU. The mortality rates at the other ICUs were: Internal Medicine (45.4%), Liver Transplantation and Medical Emergency (42.8% each), Nephrology (41.1%), Trauma (35.2%), Infec-

tious Diseases (20.0%), Surgery (19.1%), Surgical Support (11.8%) and Neurology (9.8%) units. No burn patient died in the ICU.

It was possible to monitor the daily TISS-28 score in only 242 of the 271 patients initially comprising the sample due to incomplete data. The highest mean TISS-28 score was obtained for the Liver Transplantation ICU with a score of 32 points, followed by the Trauma ICU with 28. Except for the Burn (14 points) and Infectious Diseases (18 points) ICUs which scored lowest, scores ranged from 21 to 26 points.

Daily follow-up of nursing workload

Regarding the evolution of the daily TISS-28 score (Fig. 2), the highest mean score from the first to the seventh day was obtained for the Liver Transplantation ICU compared to the other units. The opposite was observed for the Burn ICU which scored lowest almost throughout the study period. A closer distribution was observed for the other ICUs with mean scores ranging from 19.1 to 28.4 on the first day and from 17.5 to 28.8 on the seventh day. A peculiar 7 days follow-up pattern of mean scores was observed for the Hematology ICU, with a marked difference between the first and seventh day of hospitalization (22.5 and 11, respectively).

An analysis of the follow-up of the daily mean TISS-28 score and the respective number of patients showed a similar pattern in terms of decreasing number of patients from the first to the seventh day for the Surgery, Surgery Support, Neurology, Burn, Nephrology, Trauma, Internal Medicine, Infectious Diseases and Medical Emergency units. Mean TISS-28 scores observed during the same period tended

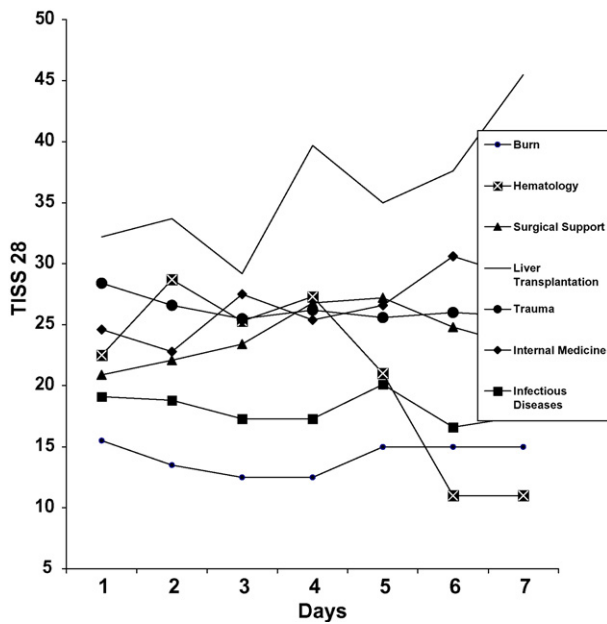


Figure 2 Mean daily TISS-28 score according to ICU. São Paulo, 2000.

to be stable. Differences in the performance of the mean daily TISS-28 scores were observed for the other units, with a marked decrease and increase in the Hematology and Liver Transplantation units, respectively (Figs. 3 and 4).

Fig. 5 shows the mean TISS-28 score according to exit condition, i.e. discharge or death, obtained for the different ICUs. The mean TISS-28 score was higher in patients who died compared to survivors in all ICUs studied, with scores ranging from 26 to 33 points, except for the Infectious Diseases unit whose mean score was 23 points. Comparison of the mean TISS-28 scores between survivors and non-survivors by the *t*-test indicated a significant difference between groups ($p=0.00$).

Table 3 shows the average time required per patient according to the mean TISS-28 score. Con-

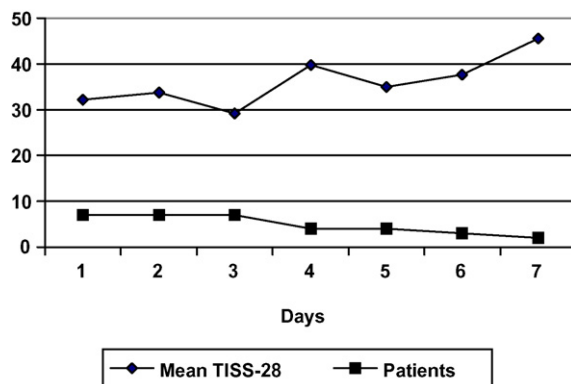


Figure 3 Mean TISS-28 score and number of patients in the Liver Transplantation ICU. São Paulo, 2000.

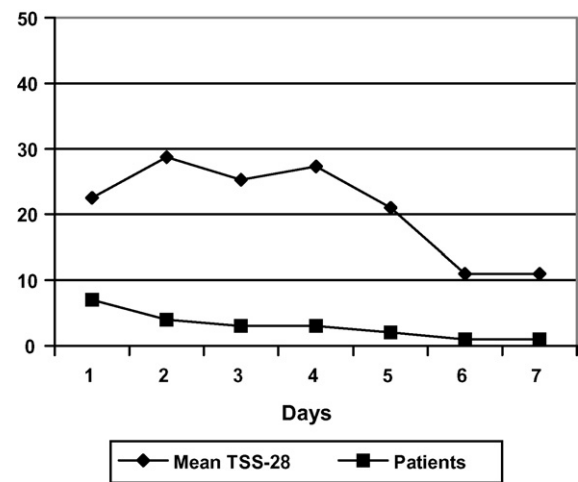


Figure 4 Mean TISS-28 score and number of patients in the Hematology ICU. São Paulo, 2000.

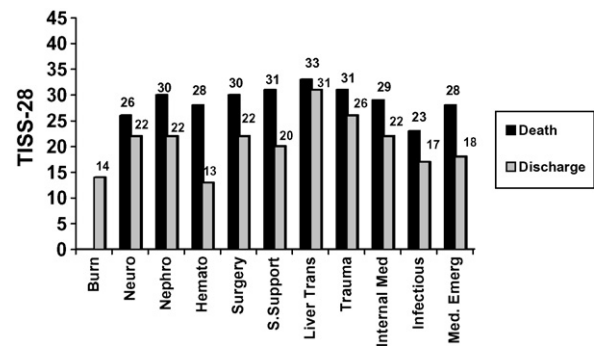


Figure 5 Mean TISS-28 score and exit conditions according to ICU. São Paulo, 2000.

Table 3 ICU according to mean TISS-28 scores and nursing work time

ICU	TISS-28	Time ^a (min)	Time remained ^b (min)
Liver Transplantation	32	339.2	20.8
Trauma	28	296.8	63.2
Hematology	26	275.6	84.4
Nephrology	25	265.0	95
Internal Medicine	25	265.0	95
Medical Emergency	23	243.8	116.2
Surgery	22	233.2	126.8
Neurology	22	233.2	126.8
Surgical Support	21	222.6	137.4
Infectious Diseases	18	190.8	169.2
Burn	14	148.4	211.6

São Paulo, 2000.

^a Mean of the nursing work time regarding that each TISS-28 point is equal to 10.6 min.

^b Mean of the nursing work time remained considering a shift of 6 h (360 min).

sidering that one TISS-28 point corresponds to 10.6 min of nursing time spent on patient care, it is important to point out that the times include only TISS activities and other direct and indirect patient care activities, but not other work activities or legitimate breaks for meals, etc. (Miranda et al., 1996).

Discussion

The hospital studied, as a highly complex large-size institution, has about 11.5% of its active beds designated as intensive care. Of the 109 beds distributed among the 11 ICUs, 79 were for surgical patients and comprised 79.0% of the sample. The remaining 30 beds were for medical patients (Internal Medicine, Medical Emergency, Hematology and Infectious Diseases) and included 25.1% of hospitalisations. In view of this distribution, the findings that most patients had been submitted to surgical treatment (66.8%) and that a higher percentage (45.5%) originated from the operating room were expected. In addition, most patients (57.9%) were admitted to the Surgery, Surgery Support and Neurology ICUs, all surgical units.

The average LOS of 7.7 (+10.4) days observed for all patients of the various ICUs was lower than that reported for other ICUs in Brazil (Silva and Sousa, 2002; Paiva et al., 2002; Ducci et al., 2004) and higher than that reported in international studies (Iapichino et al., 2004; Jakob and Rothen, 1997; Lefering et al., 2000).

The mean overall mortality of 25.0% observed in this investigation, although in agreement with Brazilian studies (Silva and Sousa, 2002; Queijo and Padilha, 2004) is higher than those reported in other studies (Miranda et al., 1996; Bastos et al., 1996; Jakob and Rothen, 1997; Ferrero et al., 1999; Metnitz et al., 1999). On the other hand, individual analysis of each ICU yielded surprising results. Although the 87.5% mortality observed for the Hematology ICU is discrepant, markedly elevated rates were also recorded for the Internal Medicine (45.4%), Medical Emergency and Liver Transplantation (42.8% each), Nephrology (41.1%) and Trauma (35.2%) ICUs. In the other units, mean mortality was less than 20.0%, with the lowest rate being observed for the Neurology ICU (9.8%).

In view of the high mortality rates observed in most ICUs, one should consider that the characteristics themselves of the hospital directed at the care of patients with highly complex illnesses, who are not attended by other services and who are often in precarious conditions that are difficult to treat, contribute to the greater severity and, con-

sequently, to a higher mortality. Another factor that might have influenced these results was the exclusion of patients hospitalised in the ICU for less than 24 h. Nevertheless, each unit needs to be analysed separately and in more detail in order to determine the influence of other variables.

With respect to the mean TISS-28 score obtained for the ICUs, only three (27.3%) units presented scores up to 21 points (Burn, Infectious Diseases and Surgical Support), whereas mean scores ranged from 22 to 26 points in the following six units (54.5%), in increasing order: Neurology, Surgery, Medical Emergency, Internal Medicine, Nephrology and Hematology. Two units (18.2%) (Liver Transplantation and Trauma) had mean scores higher than 26 points (32 and 28 points, respectively). Regarding the Burn ICU which scored lowest (14 points), it should be emphasised that mean daily scores were recorded for only four patients, although five had been admitted during the period. It is important to consider that the TISS-28 shows limitations for patients seen at this specialty (Miranda et al., 1996).

Considering that each TISS-28 point corresponds to 10.6 min of the work time of a nursing professional, within a 6-h shift, each professional would be able to care for a patient with a maximum of 34 points. Theoretically, according to this indicator, the Liver Transplantation and Trauma ICUs would require a nurse-patient ratio of 1:1, permitting the professional to also participate in some other activities in the unit. In ICUs with a mean score of 26–22 points, this ratio would be one nurse per patient, with excess time to participate in the complementary care of other patients until 34 points were reached. A 1:2 ratio would be possible in ICUs that present lower TISS-28 scores.

A multicentre study conducted at 89 ICUs in 12 European countries found a mean TISS-28 score of 26 points, with variations to higher or lower values depending on the patients seen and the type of unit (Miranda et al., 1998). Higher scores of about 30 points were also reported in a study carried out in Germany on a population of 1986 patients during a period of 40 months (Lefering et al., 2000). In Brazil, a study conducted in the city of São Paulo using a stratified sample per region found a mean score of 20 points (Silva and Sousa, 2002). However, mean scores of 26 points were reported in other Brazilian studies (Nunes, 2000; Ducci et al., 2004).

Analysis of the nursing workload follow-up over the 7 days in the Liver Transplantation ICU showed an increase in nursing workload while the number of patients decreased. This increase seems to indicate continuous investment in the treatment of patients who should have received additional thera-

peutic interventions, possibly because of worsening of their clinical conditions. The Hematology ICU, on the other hand, showed a decrease in the mean TISS-28 score after the 5th day despite a high mean score on the first days of hospitalization, a fact that might be explained by the high mortality (87.5%) and average length of stay of 5 days observed for this unit.

The mean TISS-28 score provides a valid and reliable estimate of nursing workload and severity of illness. In spite of that it should be used with caution. Aggregating other data as well as other specific severity of illness indices is needed in order to better understand the true need for ICU staff. Nevertheless, based on the premise that the more severe the condition of the patient, the larger the number of therapeutic interventions and the higher the nursing workload, the TISS-28 score provides important data for the study of the staff needed in the ICU. Current Brazilian legislation (BRASIL, 1998) recommends a nurse-patient ratio of 1:2 in critical care. This legal requirement would not appear to be adequate in the ICUs studied and might compromise the quality of patient care.

A significant difference in mean TISS-28 scores was observed between survivors and non-survivors of the different ICUs. Patients who died had a higher mean TISS-28 score than survivors, indicating these patients were more severely ill, were submitted to a larger number of therapeutic interventions and increased nursing workload. In the present study, except for the Burn ICU where no patient died during the study period, the highest TISS-28 score obtained for patients who died was observed for the Liver Transplantation ICU (33 points) and the lowest (23 points) for the Infection Disease ICU. Regardless of the maximum scores of non-survivors observed in the different ICUs, the fact that patients died confirms the severity of their conditions and the greater need for nursing care. Higher TISS-28 scores among non-survivors have also been reported in many studies (Silva and Sousa, 2002; Ducci et al., 2004; Miranda et al., 1996; Lefering et al., 2000), confirming the premise of the index and emphasizing the importance of the application of this type of score to determine the staffing required in view of the nursing workload in the ICU.

The present results contribute to the assessment of nurse staffing in ICUs, but some limitations need to be discussed. Although the TISS-28 is an international instrument which has been modified to better adjust it to the measurement of nursing workload in an ICU, some gaps still render the instrument subject to criticism since it does not include items that describe important nursing activities (Pirret, 2002; Kwok et al., 2005). In the ICU, activities

such as hygiene, family care, filling out protocols, etc.) require a substantial amount of nursing time and are fundamental when estimating nursing workload. Limitations are also related to the size of study sample and period. Undertaking the study for a longer period of time would provide more representative results. In addition, more detailed analyses of each ICU are recommended.

Despite the limitations, the availability of an international instrument that contributes to ICU staffing allocation and cost-effectiveness management justify investment in further studies. Besides that, it allows geographical and temporal comparisons between ICUs worldwide. Moreover, it is important to point out that Miranda et al., 2003, published the Nursing Activities Score (NAS) an instrument that includes the items related to nursing activities not included in the TISS-28.

References

- Bastos PG, Sun X, Wagner DP, Knaus WA, Zimmerman JE. Application of the APACHE III prognostic system in Brazilian Intensive Care Units: a prospective multicenter study. *Intens Care Med* 1996;22(6):564–70.
- BRASIL. Ministério da Saúde. Portaria n(3432 de 12 de agosto de 1998. Estabelece critérios de classificação para as Unidades de Tratamento intensivo-UTI [online]. Available at: <http://www.amib.com.br/>. Accessed February 26, 2004.
- Cullen DJ, Civetta JM, Briggs BA, Ferrara LC. Therapeutic Intervention Scoring System: a method for quantitative comparison of patient care. *Crit Care Med* 1974;2(2):57–60.
- Ducci AJ, Padilha KG, Telles SCR, Gutierrez BAO. Gravidade de pacientes e demanda de trabalho de enfermagem em Unidade de Terapia Intensiva: Análise evolutiva segundo o Therapeutic Intervention Scoring System-28 (TISS-28). *Rev Bras Terapia Intens* 2004;16(1):22–7.
- Ferrero OG, Mateo ME, Marin VG, Salas CL. Niveles asistenciales en un servicio de medicina intensiva: análisis de escalas de esfuerzo terapéutico y nivel de gravedad. *Enfermería Intens* 1999;10(1):13–21.
- Iapichino G, Gattinoni L, Radrizzani D, Simini B, Bertolini G, Ferla L, et al. Volume of activity and occupancy rate in intensive care units: association with mortality. *Intens Care Med* 2004;30(2):290–7.
- Jakob SM, Rothen HU. Intensive care 1980–1995: change in patients characteristics, nursing workload and outcome. *Intens Care Med* 1997;23(11):1165–70.
- Keene AR, Cullen DJ. Therapeutic Intervention Scoring System: update. *Crit Care Med* 1983;11(1):1–3.
- Kwok WWY, Chau JPC, Low LPL, Thompson DR. The reliability and validity of the therapeutic activities index. *J Crit Care* 2005;20(5):257–63.
- Lefering R, Zart M, Neugebauer EAM. Retrospective evaluation of the simplified Therapeutic Intervention Scoring System (TISS-28) in a surgical intensive care unit. *Intens Care Med* 2002;6(12):1794–802.
- Metnitz PGH, Vesely H, Valentin A, Popow C, Hiesmayr M, Lenz K, et al. Evaluation of an interdisciplinary data set for national intensive care unit assessment. *Crit Care Med* 1999;27(8):1486–91.

- Miranda DR, Ryan DW, Schaufeli WB, Fidle V. Organization and management of intensive care: a prospective study in European countries. In: Vincent JL, editor. Update in intensive care and emergency medicine. Berlin, Heidelberg, New York: Springer; 1998.
- Miranda DR, Rijk AD, Schaufeli W. Simplified therapeutic intervention scoring system: the TISS-28 items—results from a multicenter study. *Crit Care Med* 1996;24(1):64–73.
- Miranda DR, Nap R, Rijk A, Schaufeli W, Iapichino G. Nursing activities score. *Crit Care Med* 2003;31(2):374–82.
- Nunes B. Tradução para o português e validação de um instrumento de medida de gravidade na UTI: TISS-28 Therapeutic Intervention Scoring System [Thesis]. São Paulo 2000:Escola de Enfermagem, Universidade de São Paulo.
- Paiva AMG, Matai O, Resende NO, Campana AO. Análise de uma população de doentes atendidos em unidade de terapia intensiva: estudo observacional de sete anos (1992–1999). *Rev Bras Terapia Intens* 2002;14(2):173–80.
- Pirret AM. Utilizing TISS to differentiate between intensive care and high-dependency patients and to identify nursing skills requirements. *Intens Crit Care Nurs* 2002;18(1):16–9.
- Queijo AF, Padilha KG. Instrumento da medida da carga de trabalho de enfermagem em Unidade de Terapia Intensiva: Nursing Activities score (N.A.S.). *Rev Paul Enf* 2004;23(2):114–22.
- Silva MCM, Sousa RMC. Caracterização dos pacientes adultos e adolescentes das Unidades de Terapia Intensiva do Município de São Paulo. *Rev Bras Terapia Intens* 2002;21(1):50–7.

Available online at www.sciencedirect.com



ScienceDirect