Evaluation of Nursing Workload in Intesive Care Unit

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Abstract

Objective: Nursing workload affects patient outcomes in intensive care units (ICUs). The effective use of resources requires planning of nursing workload. We aimed to determine nursing workload, the required number of nurses in ICUs, and differences in nursing workload among ICUs using Therapeutic Intervention Scoring System-28 (TISS-28).

Material and Methods: The study was retrospectively performed in medical ICUs of the Medical Faculty, Division of Medical Intensive Care between September 1 and September 19, 2016.

Results: TISS-28 scores were calculated in 39 patients for 19 days. There were 17 patients (43.6%) in ICU-1 (9 beds), 13 patients (33.3%) in ICU-2 (8 beds), and 9 patients (23.1%) in ICU-3 (6 beds). The mean age of the patients was 66.8±17.3 years, and the mean APACHE II score was 23±7.5. The mean TISS-28 score was 27.6±5.6. APACHE II scores, TISS-28 scores, and length of ICU stay were not different among the ICUs. The number of nurses required to work in each 8-h shift was 5.1±1.2 in ICU-1, 3.6±0.5 in ICU-2, and 3.3±1 in ICU-3 ($p<0.001$). During the study period, the number of nurses actively working per shift was lower than the required number of nurses and the mean number of working nurses were 3, 3.3, and 2.3, respectively. TISS-28 scores and nursing workload for patients who died were higher than those for patients who survived ($p=0.007$ and $p=0.043$, respectively).

Conclusion: Nursing workload can be different in different ICUs, and current nursing planning is not consistent with the required numbers according to nursing workload. The number of nurses should be planned according to nursing workload rather than bed numbers or empirical values.

Keywords: TISS-28, nursing workload, intensive care

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Introduction

The monitorization, drug administrations and interventions performed for follow-up and treatment in critically ill patients who are monitored in the intensive care unit (ICU) are quite a lot. Many patient care services are performed by intensive care nurses, and nursing service can directly affect survival (1-3). It is necessary to determine nursing workload for the effective use of resources in intensive care and to plan the organization of the unit in the light of these evaluations. Thus, adequate treatment can be provided, and patient safety and survival are improved (4, 5). It is difficult to evaluate nursing workload in intensive care units objectively. The therapeutic intervention scoring system-28 (TISS-28) is a method used for this purpose (6). The TISS-28 has been reported to have a good relationship with the severity of a disease in addition to being the indicator of nursing workload in ICUs (7).

The TISS is an intensive care scoring system developed in 1974, which determines the severity of a disease according to the procedures performed for the diagnosis, treatment and monitoring of ICU patients. The TISS, which was a scoring system reflecting the severity of a disease at the beginning, is currently used in the evaluation of nursing activities. The number of procedures in the TISS, in which 57 procedures were initially evaluated, has been reduced to 28, and it has been continued to be used under the title TISS-28 (8).

The scores range from 1 to 78 in the TISS-28 that consists of seven main sections, including basic activities, respiration support, cardiovascular support, renal support, neurological support, metabolic support and special interventions, and a total of 28 sections (Table 1) (9).

The relationship between the TISS-28 score and the time spent at the bedside for all nursing activities is linear, and a score in the TISS-28 corresponds to 10.6 minutes spent at the bedside (8). The TISS-28 score that allows all nurses in the intensive care unit to

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work in accordance with their capacity is accepted to be 46. This is closely associated with the management of intensive care nursing workload. The patient/nurse ratio in tertiary ICUs is recommended to be 2:1, but this ratio is empiric, and even this ratio cannot be achieved for many centers (10). Furthermore, nursing workload may be different depending on the diagnosis and disease characteristics of patients who are monitored in different ICUs. However, in practice, planning is usually based on the number of beds or empirical recommendations. The characteristics of ICUs (whether there is a sufficient number of doctors, open/closed intensive care functioning, whether there is an intensive care specialist director, monitorization and device/intervention opportunities, etc.) may also directly affect nursing workload. The patient/nurse ratio, which is recommended to be 2:1 in tertiary ICUs, is recommended to be 1:1 and even 1:2 as the number of organ support treatments increases, for example, in patients to whom supportive care is applied such as extracorporeal membrane oxygenation (10).

Our objective in planning this study was to calculate nursing workload in our intensive care units, the required number of nurses in ICUs, and differences in nursing manpower among ICUs using the TISS-28.

Material and Methods

The study was conducted in a university hospital's Division of Medical Intensive Care tertiary ICUs in accordance with the Declaration of Helsinki. The patients in a 9-bed ICU-1, 8-bed ICU-2 (oncology intensive care unit to which critically ill cancer patients are mainly admitted) and 6-bed ICU-3 (intensive care unit in which patients who do not require interventional procedures, such as continuous renal replacement therapy, invasive hemodynamic and cardiac monitoring applications are mainly hospitalized) between September 1, 2016 and September 19, 2016 were included in the study. The patients' demographic characteristics, APACHE II values, TISS-28 scores, causes of admission to ICU, places of admission before ICU were retrospectively recorded from the patient records. The patients' TISS-28 evaluations were recorded daily at the same time (09:00) until the patient left the ICU (transfer or death). Each TISS-28 score was evaluated as 10.6 minutes spent at the bedside (8). The nursing workload was calculated using the TISS-28 scores, intensive care number of beds and working hours. The number of nurses required to work in each shift was determined by calculating the ratio of nursing workload to working time. (Number of nurses = Length of care X Number of beds / Length of shift). The TISS-28 values between the units were compared.

Statistical Analysis

SPSS 21.0 (Statistical Package for the Social Sciences Inc.; Chicago IL, USA) was used for statistical evaluation. The values were given as number (percentage) for categorical variables and as mean±standard deviation (SD) for continuous variables. The Mann-Whitney U test was used in pairwise group comparison, Kruskal-Wallis test was used in triple group comparison, and Chi-square test was used in the comparison of categorical variables. The number of nurses actively working per shift and the required number of nurses were compared using a paired t-test. The multivariate logistic regression analysis was applied to variables with a p-value of <0.20 as a result of the univariate analysis. The p-value <0.05 was considered significant.

Table 1. Therapeutic intervention scoring system (TISS-28) scoring form (8)

Basic Activities	Score
Standard monitorization: Hourly vital signs, regular fluid monitoring and loss	5
Laboratory: Biochemistry and microbiological tests	1
Single drug administration, any way (oral, intravenous, intramuscular, etc.)	2
Multiple intravenous drug administration (bolus or continuous infusion)	3
Regular change of clothes: Care, decubitus care, daily change of clothes	1
Frequent change of clothes (at least once per shift) and/or heavy wound care	1
Monitoring of drains (excluding gastric tube)	3
Single vasoactive drug administration (any)	3
Multiple vasoactive drug administration (independent of type and dose)	4
Intravenous replacement in severe fluid losses (Approximately 5 L/day, independent of the given fluid)	4
Peripheral arterial catheter	5
Left atrium monitoring: Pulmonary artery catheter	8
Central venous catheter	2
Cardiopulmonary resuscitation within the last 24 hours	3
One-time special interventions (Intubation, cardiac pacing, cardioversion, endoscopy, emergency surgical intervention within the last 24 hours, gastric lavage)	3
Multiple special interventions (at least two of the above)	5
Interventions performed outside of the ICU: Surgical or interventional	5
Mechanical ventilation: Positive end-expiratory pressure assisted/unsupported all assist modes, positive end-expiratory pressure with spontaneous ventilation	5
Complementary ventilation support: Spontaneous ventilation with endotracheal tube without positive end-expiratory pressure	2
Artificial airway care: Endotracheal tube, tracheostomy	1
Treatment for correcting lung functions: Chest physiotherapy, spirometry, inhalation therapy, intratracheal aspiration	1
Hemofiltration	3
Monitoring of urination	2
Active diuresis administration (Furosemide> 1 tablet or 2 ampuls/day)	3
Intracranial pressure measurement	4
Complicated metabolic acidosis/alkalosis treatment (pH<7.30 or >7.45)	4
Intravenous hyperalimentation	3
Enteral feeding (with tube or other gastric pathways-gastrostomy)	2

Table 2. Characteristics of the patients

	All Patients n=39	ICU-1 n=17	ICU-2 n=13	ICU-3 n=9	p
Age	66.8±17.3	68.4±20.1	64.1±8.3	68.4±17.2	0.470
Male sex, n (%)	17	8 (52.9)	7 (46.2)	2 (22.2)	0.320
Admission diagnosis, n (%)					0.201
Respiratory distress	22 (56.4)	11 (64.7)	7 (53.8)	4 (44.4)	
Sepsis	13 (33.3)	5 (29.4)	5 (38.5)	3 (33.3)	
Other	4 (10.3)	1 (5.9)	1 (7.7)	2 (22.2)	
Place of admission before ICU					0.820
Emergency room	20 (51.3)	8 (47.1)	7 (53.8)	5 (55.6)	
Internal medicine ward	14 (33.3)	7 (41.2)	5 (38.5)	2 (22.2)	
Non-medical ward	4 (10.3)	1 (5.9)	1 (7.7)	2 (22.2)	
Outside hospital	1 (2.6)	1(5.9)	0	0	
APACHE II (mean±sd)	23.0±7.5	24.6±6.8	20.4±8.3	26.3±6.1	0.270
TISS-28 (mean±sd) per patient	27.6±5.6	27.1±6.0	28.5±4.8	27.3±6.6	0.680
Workload, minute* (mean±sd)	293.0±60.2	287.4±63.0	302.0±51.0	284.7 ± 70.3	0.690
Required number of nurses** (mean±sd)		5.1±1.2	3.6±0.5	3.3±1	<0.001
Mean number of nurses actively working		3	3.3	2.3	<0.001
Length of stay, day	9.4±5.6	9.1±5.1	8.4±5.4	11.3±6.0	0.600
Mortality, n (%)	7 (17.9)	2 (11.8)	4 (30.8)	1 (11.1)	0.740

* The time spent at the bedside was calculated by accepting 10.6 minutes for each TISS-28 score.

** Number of nurses = workload, hour (workload, minute/60) X Number of beds / Length of shift

ICU: Intensive care unit; TISS-28: Therapeutic intervention scoring system-28; mean±sd: mean±standard deviation

Table 3. Comparison of patients who died and who survived

	Those who died n=7	Those who survived n=32	p
Age	67.0±15.0	65.2±19.0	0.820
Admission diagnosis, n (%)			0.638
Respiratory distress	4 (57.1)	18 (56.3)	
Sepsis	3 (42.9)	10 (31.3)	
Other	0	4 (12.6)	
Place of admission before ICU, n (%)			0.417
Emergency	2 (28.6)	18 (56.3)	
Internal medicine ward	4 (57.1)	9 (28.1)	
Non-medical ward	1 (14.3)	3 (9.4)	
Outside hospital	0	1 (3.1)	
APACHE II (mean±sd)	24.5±9.4	21.2±5.4	0.350
TISS-28 (mean±sd)	30.0±5.9	23.5±4.8	0.007
Workload, minute (mean±sd)	318.0±63.0	249.1±51.7	0.043
Length of intensive care unit stay, day (mean±sd)	8.8±6.1	6.5±3.8	0.570

* The time spent at the bedside was calculated by accepting 10.6 minutes for each TISS-28 score.

ICU: Intensive care unit; TISS-28: Therapeutic intervention scoring system-28; mean±sd: mean±standard deviation

Results

The TISS-28 value records of a total of 39 patients in three intensive care units for 19 days were calculated. When the causes of admission were assessed, respiratory failure was observed to be the most frequent cause of admission. Patients were often admitted to ICUs from the emergency department (Table 2). 76.9% of patients admitted to ICU-2 were cancer patients.

Seventeen patients (43.6%) in ICU-1, 13 patients (33.3%) in ICU-2, and 9 patients (23.1%) in ICU-3 were monitored. The mean age of the patients was 66.8±17.3 years, and the mean APACHE II score was 23±7.5. The mean TISS-28 score was calculated to be 27.6±5.6. No significant relationship was observed between the APACHE II and TISS-28 (r=0.18, p=0.34).

The nursing workload was calculated to be 48.3 hours in ICU-1, 41.3 hours in ICU-2 and 21.6 hours in ICU-3 for each 8-hour shift. The number of nurses required to work in intensive care units in each 8-h shift was calculated to be 5.1±1.2 in ICU-1, 3.6±0.5 in ICU-2, and 3.3±1 in ICU-3. The mean number of nurses actively working in intensive care units on the same dates was 3 in ICU-1, 3.3 in ICU-2 and 2.3 in ICU-3. The number of nurses actively working per shift was 4/3/2 in ICU-1, 4/3/3 in ICU-2 and 3/2/2 in ICU-3. A significant difference was observed between the number of nurses actively working and the required number of nurses in three intensive care units (ICU-1, ICU-2, ICU-3) (p<0.001, p<0.001, p= 0.002, respectively) .

It was observed that seven patients (18%) died in our intensive care unit. When the patients who survived and the patients who died were compared, it was observed that the TISS-28 scores and nursing work-

load for patients who died were higher than those for patients who survived (Table 3) (p=0.007, p=0.043, respectively). The effect of the TISS-28 values and nursing workload on mortality could not be shown in the logistic regression analysis.

Discussion

In this study, the TISS-28 scores of a total of 39 patients in our tertiary intensive care units were evaluated for 19 days, and the nursing workload and required number of nurses per shift were calculated. Although there was no difference between the TISS-28 scores among intensive care units; in the calculations performed using the number of beds and nursing workload, it was remarkable that there was more workload and the required number of nurses was high in ICU-1. The admission of more severe patients who required invasive procedures during admission to ICU-1 accounts for the high workload.

The facts that patients with severe shock and acute respiratory distress syndrome requiring acute interventional treatment and continuous renal replacement therapy are primarily admitted to ICU-1 among intensive care units and the number of beds of ICU-1 is higher compared to other intensive care units may explain the high number of nurses required per shift. 76.9% of the patients staying in ICU-2 were cancer patients. The fact that these patients are mostly palliative patients and therefore require less invasive intervention may explain the smaller number of nurses required. Different TISS-28 scores in different intensive care units were reported in previous studies (11). In the study including 271 patients carried out by Padilha et al. (7) in different intensive care units, the mean TISS-28 score was found to be 23, the highest TISS-28 score was found in the ICU in which liver transplantation patients were monitored, the lowest TISS-28 score was found in the burn ICU, and a correlation was determined between the severity of a disease and high TISS-28 score. In the present study, no significant relationship was observed between the APACHE II and TISS-28; however, the fact that the required number of nurses was found to be high in ICU-1 where patients requiring more intensive monitoring and treatment stay can be explained by the small number of patients in the study.

In a retrospective study carried out by Muehler et al. (12) on 6903 patients in the surgical intensive care unit, a significant correlation was determined between the disease type and mortality and TISS-28 score (12). In their study, Colpan et al. (13) examined a total of 334 patients and found a significant relationship between mortality and TISS-28 scores. In the current study, the TISS-28 values of the patients who died were also found to be high. This is an expected result. Since the intervention and/or monitorization procedures performed in a patient whose condition becomes more serious will increase, the workload naturally increases, and the time spent at the bedside is also extended. Similar results were also reported in previous studies (11, 12).

When it is considered that each TISS-28 score takes 10.6 minutes, a care of up to 45 points can be provided for a patient during an 8-hour shift. Accordingly, it was estimated that the patient-nurse ratio should be 1:1 in intensive care units in which liver transplantation patients are theoretically monitored. In intensive care units with a TISS-28 score of 22-26, the ratio can be calculated to be 1:2. When it is considered from this point of view, the mean TISS-28 calculated in our units and the required number of nurses on each shift will be appropriate for our 2nd and 3rd ICUs according to the 1:2 nurse ratio stated in the literature. However, this ratio is small for ICU-1. When the number of actively working nurses is examined, it is reduced to 2 on the night shift in ICU-1 where there should be a maximum number of nurses. Although the number of nurses in ICUs 2 and 3 during the day is close to the required numbers, it is observed that this number is also low in these units during the night shift. This shows that the number of nurses in intensive care units should be planned according to workload rather than empirically or by the number of beds and that it is important to evaluate all data when service planning is done. Not only intensive care scores but also patient admission criteria, the number and type of invasive procedures should be evaluated.

It is reported that nursing workload significantly increases in the units with a shorter length of stay because the patient discharges are more (14). In the present study, although the lengths of stay among intensive care units were not significantly different, the mean length of intensive care unit stay was found to be high in ICU-3 compared to other ICUs. It was considered that this was associated with the recent admissions of patients to ICU-3.

Our results are important in terms of determining the required number of nurses in intensive care units. However, this study has limitations. Firstly, the present study was carried out with a limited number of patients. It is expected that the results will be more determinant if it is carried out with more patients. This study was carried out in three intensive care units that provide service only as an medical intensive care unit. The results are valid for only three intensive care units. Since other intensive care units were not included in the study, it does not provide information about nursing workload and the need for nursing manpower in these intensive care units. The study was a retrospective cross-sectional study and evaluated the 19-day process.

In conclusion, nursing workload can be different in different ICUs. It is important to calculate nursing workload in intensive care units and to regulate the number of nurses according to needs.

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