Validation of “nine equivalents of nursing manpower use score” on an independent data sample

Abstract  Objective: To compare the recently developed “nine equivalents of nursing manpower use score” (NEMS) with the simplified Therapeutic Intervention Scoring System (TISS-28).

Design: Prospective single centre study.

Setting: Adult 30-bed medical-surgical intensive care unit (ICU) in a tertiary care university hospital.

Patients: Data from all patients admitted in 1997 to the ICU were included in the study.

Methods and results: NEMS and TISS-28 items were recorded prospectively for each nursing shift. There were three shifts per day. The Simplified Acute Physiology Score (SAPS) II was calculated for the first 24 h of ICU stay and each patient’s basic demographic data were collected. The agreement between NEMS and TISS-28 was assessed by calculating the mean difference and the standard deviation of the differences between the two measures. Further, regression techniques and Pearson’s correlation were used. Altogether, 2743 patients with a total of 28'220 nursing shifts were included; 62% of the shifts were used for postoperative/trauma patients and 38% for medical patients. Mean NEMS was 26.0 ± 8.1 and mean TISS-28 was 26.5 ± 7.9. The scores differed by ≤ 3 points in 49% of all shifts. The bias was −0.5 ± 5.3 (95% confidence interval −0.47 to −0.60) and the limits of agreement were −11.1 to +10.1. The relation between the two systems was NEMS = 4.7 ± 0.8 · TISS-28 (r = 0.78, r² = 0.62, p < 0.001). Including postoperative/trauma patients only: NEMS = 1.9 + 0.9 · TISS-28, for medical patients this equation was: NEMS = 6.0 + 0.8 · TISS-28. First-day SAPS II explained 11% of the variability in first-shift NEMS and 5% of the variability in first-shift TISS-28.

Conclusions: This study confirms a good agreement between TISS-28 and NEMS in a large, independent sample. However, as shown by the differences between medical and postoperative/trauma patients, a change in case mix may result in different regression equations. Further, wide limits of agreement indicate that there may be a rather large variability between the two measures at the individual level.

Key words  Simplified Therapeutic Intervention Scoring System · TISS-28 · NEMS · Nursing workload · Nursing manpower
Introduction

Intensive care is associated with a high resource use. As an example, about 10% of all health care costs may be consumed by critical care units and this may result in expenditures close to 1% of the gross national product [1]. Even though there are important methodological problems with costing for hospital services [2], a number of different methods to estimate cost in the intensive care unit (ICU) have been presented recently [3–6]. Manpower use is a major contributor to costs. It is estimated to comprise up to two-thirds of the total ICU costs [7]. Accordingly, one often used indicator of cost is the Therapeutic Intervention Scoring System (TISS), initially developed by Cullen et al. in 1974 [8]. The original TISS consists of a set of 57 parameters selected from different activities, typically performed in the ICU. Later, TISS was expanded (now including 76 items) and adapted to changes in ICU practice [9]. Because the daily collection of 76 TISS items may be time consuming, a simplified version, TISS-28, was presented in 1996 [10]. Initially designed to assess severity of illness, TISS may be used to evaluate the adequacy of planning and practice in nursing staff [11], to define the level of care [12], to estimate workload [13], to measure general resource use [4] and to calculate ICU costs [13–15] and even cost effectiveness [16].

Because all versions of TISS (including TISS-28) still are fairly extensive and time consuming, for example, if used in large epidemiological studies, the “nine equivalents of nursing manpower use score” (NEMS) was developed recently [17]. NEMS was constructed using a database collected in 22 adult general, medical and surgical Dutch ICUs and validated using a sample from the EURICUS-I (European ICU study) database by the same authors [17]. However, the agreement between NEMS and other measures of nursing workload has not been analysed in detail by other authors.

The aim of the present study was to compare, on an independent sample and in a different European country, NEMS with TISS-28.

Materials and methods

Study population

The study was carried out in an adult 30-bed ICU in a tertiary care, university-based hospital. The ICU is divided into three postoperative/trauma units (with a total of 18 beds) and two medical units (12 beds). Data from all patients admitted to the ICU between 1 January 1997 and 31 December 1997 were included in the study. Basic demographic data were collected for each patient, and the Simplified Acute Physiology Score (SAPS) II [18] was calculated for the first 24 h of ICU stay.

Estimation of nursing workload

NEMS and TISS-28 items were recorded for each nursing shift [17]. NEMS includes the following nine items (points assigned to each item in parentheses): basic monitoring (9), intravenous medication (6), mechanical ventilatory support (12), supplementary ventilatory care (3), single vasoactive medication (7), multiple vasoactive medication (12), dialysis techniques (6), specific interventions in the ICU (5) and specific interventions outside the ICU (6). For further details, see Miranda et al. [17].

There were three shifts per day. At the end of each shift, the nurse responsible for the respective patient completed a data form. Data were collected in the same way for all shifts. Thus, if a patient stayed in the ICU only during a part of a shift, no correction was made. Within each of the five units of the ICU this process was checked by the senior nurse of the unit. This included a review of all forms. Further, data collection was supervised by one of the head nurses of the ICU (V.K.).

In addition to calculations of NEMS and TISS-28, the patients were categorised according to the grading system of the Swiss Society of Intensive Care (SGI) [19, 20]. In this system, the nurse assigns the patient to one of four workload categories. The categories are defined as: category IA = more than one certified nurse per patient and shift (≥ 8 h), category IB = one certified nurse per patient and shift, category II = one certified nurse per two patients and shift and category III = one certified nurse per three patients and shift. This grading system has been in use in most Swiss ICUs for about 20 years.

The agreement between NEMS and TISS-28 was assessed by calculating the mean difference d (= bias) and the standard deviation (SD) of the differences between the two measures [21]. Also, the distribution of the differences was checked by a normal probability plot. The limits of agreement between the two measures were calculated (= d ± 2·SD) [21]. Further, regression techniques and Pearson’s correlation were used.

Workload scores versus severity of illness score

For each patient, SAPS II [18] was calculated for the first day of ICU stay. To compare SAPS II with the first-shift NEMS and TISS-28 respectively, a linear regression was calculated.

Statistical analysis

If not stated otherwise, data are shown as mean and standard deviation. The agreement between NEMS and TISS-28 was assessed using the methods proposed by Bland and Altman [21]. Further, regression techniques including Pearson’s correlation coefficient were used. For major variables, 95% confidence intervals (CI) are given [22]. For all calculations, the SYSTAT 7.0 computer software package (SPSS Arlington, Va., USA) was used.

Results

Overall, 2743 patients with a total of 28220 shifts of nursing were included; 62% of the shifts were used for postoperative/trauma patients and 38% for medical patients. The general characteristics of the patients are presented in Table 1. Overall, 56% of the patients received mechanical ventilation, and in 6% artificial renal