
Assessment of Nurses' Workload in Intensive Care Unit by Use of Scoring Systems

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Abstract

Aim. To assess the level of correlation between two scoring systems: patient categorization according to the Croatian Nursing Council consensus and Nine Equivalents of Nursing Manpower Use Score (NEMS) and their ability to determine if the number of nurses working in the intensive care unit (ICU) is optimal to provide adequate nursing care, and to assess the level of correlation between the severity of patients' illness and the level of nurses' satisfaction with provided care.

Methods. Research was performed in surgical ICU of the Clinical Department of Anesthesiology, Re-

suscitation and Intensive Care Medicine, University Hospital Dubrava, in the period between January 8th and April 14th, 2014. 256 patients aged 18-92 years were included in the study. Patient categorization and NEMS were calculated each day during the first 7 days of the ICU stay. NEMS was calculated using a pre-made table of variables and categorization was calculated using an electronic form included in nursing electronic patient files. Satisfaction of provided care was expressed using the Likert scale (1-5).

Results. Study results have shown a moderate but significant level of correlation between the categorization and NEMS scores. Mean NEMS score during the first 7 days in the ICU was 26.93 ± 4.64 and the highest measured values were at day 4 (30.34 ± 8.1) after which they started decreasing. Mean cumulative NEMS throughout the whole ICU stay was 269.3. According to the fact that according to NEMS scoring system one nurse can provide maximum of 45 points for 24 hours, the results have shown that a 10 bed ICU needs at least 5.98 (6) nurses to provide adequate level of care. Average categorization score was 57.83 ± 4.29 and the highest recorded score was at day 7 (59.7 ± 4.44). According to the categorization scoring system time needed to provide care for one 4th category patient throughout 24 hours is 10 or more hours. Since the description of the 4th category doesn't specify what is the upper limit of time needed to provide care for each patient, 14 hours was used to determine a minimum number of nurses, and according to the categorization score 5.83 (6) nurses are needed in the ICU. Nurses' satisfaction with provided care has shown a significant negative correlation with NEMS score and categorization score.

Conclusion. Both scoring systems can be used to assess nursing workload in a surgical ICU. However, NEMS is simpler and quicker to use, more applicable, useful and should be routinely used in place of categorization to assess nursing workload in surgical ICUs.

Introduction

Intensive care medicine (ICM) is a multidisciplinary and multiprofessional area in medicine, providing the highest level of medical management and it includes monitoring, caring, treating and ensuring life support measures for severely ill or seriously injured patients. In the management of critically ill patients, Intensive Care Unit (ICU) is the most expensive part of the healthcare system. Work in the ICU requires knowledge, continuous medical education, skills and experience of all healthcare workers involved, especially nurses. Daily introduction of new technologies, methods, medicines, procedures and treatment strategies continue to make the working scope of a nurse ever more complex, bearing in mind that providing the best care for patients and their families is a nurse's responsibility.

High costs of ICM, quality of care and patient safety require assessment of nurses' workload in order to determine adequate conditions that are relevant, both for planning of care and for managing human resources (1). Assessment of nurses' workload already began in the 1970s as a result of a need for determining the severity of illness, cost analysis and efficiency in the ICU. In the following decades there was a need for specific tools to measure the workload, which resulted in development of scoring systems focusing on nurses' activities (2). Scoring systems are becoming more important tools for ICU workload assessment and comparison of effect of outcomes of different ICUs in quality assessment projects (3). It has already been shown that the optimal number of nurses is a key prerequisite for good quality of care in ICUs (4).

Different international associations have stressed the importance of optimal staffing numbers in order to increase patient safety, reduce the number of complications and costs (5, 6). Newer evidence shows that reduced numbers of nurses in the staff decrease the quality of care, which results in increased risk of nosocomial infections (7), occurrence of decubitus (8), postoperative complications, extension of hospital stay duration and mortality increase (9). Increased nurses' workload also has an effect on occurrence of burnout syndrome and more frequent requests for transfer or change of job (10).

Measurement of healthcare costs, as well as measuring the use of human resources in healthcare system is a challenging task, especially as it is both difficult and expensive to measure resource use in healthcare systems and clinical outcomes. These require development of special assessment tools that are practical, unique, reproducible and detailed enough to allow comparison between various institutions, patient groups and individual patients (3).

Optimal number of nurses is a key prerequisite for quality of care in ICUs, however this issue is not as simple as it seems. The incidence of burnout and lack of work satisfaction are inversely proportional to the ratio of numbers of patients and nurses responsible for their care (11). On the other hand, more working places considerably increase costs, with limited financial resources being one important obstacle in employing more nurses at those workplaces. As a direct result of this mismatch, adjusted therapeutic indexes have been developed in order to optimally count, assess and distribute nurses in ICUs (12).

The number of nurses in the ICU is of extreme importance and therefore the assessment of workload is currently the most reliable indicator for establishing optimal numbers of staff. As in recent period there has been a trend towards admitting elderly patients with more comorbidities into ICUs, in combination with newer treatment methods this has resulted in increase in nurses' workload (13).

Background

Scoring systems in ICU

Scoring systems in use for critically ill patients are nowadays widely used in ICUs because they can predict the outcome, evaluate the severity of the disease and organ dysfunction level, as well as assess the use of human resources. They can be divided into two groups: those specific for organ systems or diseases (such as *Glasgow Coma Scale*) and those generally for all patients in ICUs (14).

The purpose of scoring systems is to objectively, accurately and reliably measure the severity of the

disease; as such, they are very useful for clinical decision making, evaluation of course and outcome of a disease, quality of care and assessment of health-care personnel workload (12). In the last 20 years, the development of scoring systems in ICUs is mostly warranted by every increasing complexity of possibilities for intensive treatment, as well as increasing treatment costs; all of this results in the need for assessment of patients' condition to be as objective as possible.

Ideal scoring system should have following characteristics: simplicity and possibility to record needed variables routinely, good calibration, high level of specificity, applicability to all populations and in all countries, capability of predicting functional state and quality of life after discharge from the ICU. At this moment, no scoring system fulfils all of those criteria (15).

At this point, it is also important to note that different scoring systems have different purposes and measure different variables, they should be seen as complementing each other, instead of competing against each other. It is well possible that their combined use could provide more accurate indicators of disease severity and prognosis. All these scoring systems should adapt to time, as does the type of patients being admitted to ICUs (as a result of availability of new diagnostic, treatment and prognostic techniques) (14).

Patient categorization

Categorization is a system of assigning categories to patients with regard to certain characteristics, depending on the amount of care the patient needs. The need for such a process was first recognized at the beginning of the 20th century, and it was significantly enhanced during the 1950s and 1960s with introduction of the "progressive care" concept. Initially, categorization was developed with the intention to show in an easy to understand manner systemic workload and to make it possible for staff needs to be calculated; as time progressed, staffing policy and analysis of costs, efficiency and productivity were added.

This process provides quick insight into the level of the severity of patients' conditions, showing at the same time required levels of care and number of nurses required to provide adequate care. Two approaches are possible: either through description of individual factors characteristic for each category or

through separate scoring of individual factors and calculation of mean values, which then represents the patient's category. Critical factors are indicators that represent activities which most affect the time spent on providing nursing care.

Categorization in Croatia is performed according to a consensus document issued by Croatian Nursing Council (CNC) which was published in 2006 (16). Patients can be assigned into 4 categories according to the level of help needed to satisfy basic human needs and according to diagnostic and therapeutic procedures performed on each patient. Those factors directly determine the level of care nurse provides, as well as the number and complexity of interventions (16). Through a separate legally binding document categorization has become an obligatory procedure since 2011. To further elaborate on this procedure, it is important to know that following variables are used to determine critical factors: independency evaluation, physical activity, risk of fall, state of consciousness, risk for decubitus formation, vital signs, communication, specific procedures in care, diagnostic procedures, therapeutic procedures and education (16). Using a point system, patient's condition is assessed daily by the nurse according to those factors and depending on the level of needs, the end result is that patient is assigned a category on a scale of 1-4. Whereas in category 1 the patient is independent in performing daily activities of life, in category 4 the patient is completely dependent in performing daily activities of life. According to the result of a pilot survey conducted in 2005 in 7 institutions in Croatia, CNC made the following recommendation concerning time required per patient in each category during 24 hours: category 1 - self-care: 1-2 hours; category 2 - minimal care: 3-5 hours; category 3 - intermediary care: 6-9 hours; category 4 - intensive care: 10 hours and more (16).

Patient categorization allows quick insight into patients' needs for care in a ward, changes in condition during the day and from day to day, it facilitates organisation of care and planning of needs for nurses in wards.

Nine Equivalent of Nursing Manpower Use Score (NEMS)

There has also been a development of different scoring systems to determine the required levels of provided intensive care and those systems can

provide useful additional information on the severity and prognosis of a disease, the needed number of nurses and their workload (17). One of the most widely known is NEMS (*Nine Equivalentents of Nursing Manpower Use Score*) which has been derived from TISS and TISS-28 scoring systems (18). NEMS is recognized globally because of its simplicity and the fact that it doesn't require a lot of time for use (3).

Until a few years ago, most often used indirect scoring systems in ICUs were *Therapeutic Intervention Scoring System* (TISS) and *Nine Equivalentents of Nursing Manpower Use Score* (NEMS). TISS was used since 1974, and is based on classification of patients according to the severity of the disease. It was further modified on several occasions, resulting in the appearance of TISS-28 in 1996, focusing on 28 therapeutic activities and level of use of nurses' time needed to execute those activities. This system was criticised for its assumption that the number and type of interventions depend on the severity of the disease and the amount of work with the patient; furthermore, the complexity of the scoring system was quite time-consuming. This resulted in a simplified version of TISS-28 in 1997, where only 9 variables are used, and the system was named NEMS. NEMS's greatest advantage is that it's easier to perform, and its greatest disadvantage is the reduced sensitivity for small changes in the clinical status of the patient, which do affect the care the nurse provides (19,20).

NEMS scoring system is widely used today for its simplicity and speed of scoring as it uses 9 general categories of activities of nurses and factors that are patient-related, which have influence on nurses' workload during administering care (13). Nurses' activities which NEMS measures are: basic monitoring, intravenous therapy, mechanical ventilation, additional breathing support, use of one vasoactive medication, use of multiple vasoactive medications, dialysis, specific ICU interventions and specific interventions outside of ICU (some interventions are mutually exclusive). Patients can be assigned 0-56 points, and one nurse can process a maximum of 45-50 points during 24 hours (2,13,17).

Aim

To assess the level of correlation between two scoring systems: patient categorization according to Croatian Nursing Council consensus and Nine Equivalentents of Nursing Manpower Use Score (NEMS) and their ability to determine if the number of nurses working in the intensive care unit (ICU) is optimal to provide adequate nursing care, and to assess the level of correlation between the severity of patients' illness and the level of nurses' satisfaction with provided care.

Methods

This prospective study was performed at the ICU of the Department of Anaesthesiology, Resuscitation and Intensive Medicine at University Hospital Dubrava during the period between January 8th and April 14th 2014. The ICU has 10 beds where all the surgical patients are treated, except for those requiring cardiac or vascular surgery. Researchers recorded patients' demographic and clinical variables, and categorization (cumulative score which defines 4 categories of patient's independence and ability to perform daily tasks defined by the Croatian Nursing Council consensus (16)) and NEMS scoring were performed every day, from the first until the seventh day of hospital stay in the ICU for every patient at 10 AM. Both scores were calculated by nurses which provided care for each evaluated patient at the time of measurement. Data from the preceding 24 hours were also recorded from medical documentation and included into the database. NEMS scoring was performed with the use of the appropriate table and instructions provided (17), and categorization scoring was entered electronically into nurses' documentation of patients.

Likert scale was used to record nurses' satisfaction at the time of patient discharge from the ICU with the level of care they provided using marks 1 (completely dissatisfied), 2 (dissatisfied), 3 (neither satisfied nor dissatisfied), 4 (satisfied) and 5 (completely satisfied).

In order to conduct this study, the approval from the Ethical Committee of University Hospital Dubrava was requested and received.

Participants

There were in total 265 patients enrolled into this study, between 18 and 92 years of age. Patients younger than 18 and those that spent less than 24 hours in the ICU were considered to be ineligible for participation. Participants were grouped according to their diagnoses (operations) into 8 groups: abdominal surgery, neurosurgery, thoracic surgery, maxillofacial surgery, trauma/orthopaedics, polytrauma, urology and plastic surgery. During the period when this study was conducted there were a total of 24 nurses employed at the ICU, 4 have finished undergraduate education (17%) and 20 nurses have finished nursing school (83%). ICU nurses work in shifts of 12 hours, and in every shift there were 4-5 nurses.

Statistics

Data is presented in tables and graphs. Analysis included descriptive statistics with absolute frequencies and corresponding prevalences. Additionally, a total number of points was calculated for both scoring systems and analysis of variance was used to analyse mean scoring system values in relation to patients' diagnoses/wards. Furthermore, Pearson's correlation coefficients were calculated for NEMS scoring system, categorization scoring system and nurses' opinions about the provided care. All *p* values of 0.05 or less were considered to be significant. Statistical analysis was performed using data analysis software system STATISTICA, version 10.0 (StatSoft, Inc. (2011), www.statsoft.com).

Results

Descriptive statistics of participants are presented in Table 1. Almost two thirds of the patients were male, and more than 50% of the patients were from the Abdominal Surgery Ward. 90 (34.0%) patients were admitted through the Emergency Ward, and in the observed period 23 (8.7%) died.

Table 1. Descriptive statistics of participants (N=265)

		N	%
Sex	Male	172	64.9
	Female	93	35.1
Diagnosis (groups)	Abdominal surgery	134	50.6
	Neurosurgery	64	24.2
	Thoracic surgery	23	8.7
	Maxillofacial surgery	16	6.0
	Trauma/Orthopaedics	2	0.8
	Polytrauma	5	1.9
	Urology	20	7.5
	Plastic surgery	1	0.4
Emergency admission	No	175	66.0
	Yes	90	34.0
Outcome	Alive	242	91.3
	Dead	23	8.7

Table 2 shows descriptive statistics of selected quantitative variables from this study. Mean age of participants was 62.82 ± 13.38 years, while the median of length of stay in the ICU in days was 1 day (interquartile range from 1 to 2 days).

Mean NEMS score during the first 7 days of hospitalization was 26.93 ± 4.64 and was highest during the 4th day (30.34 ± 8.10), after which it started to decline (Figure 1). NEMS score are in the range from 0-56.

Mean categorization score value was 57.83 ± 4.29 , and the highest categorization score value was during the 7th day (59.70 ± 4.44) (Figure 2). Categorization scores are in the range from 16 to 64.

Nurses' satisfaction with quality of provided care was satisfactory and graded with the mean grade of 4.28 ± 0.50 (which means they were very satisfied with the work done). There weren't any grades 1 or 2 recorded.

Mean patient NEMS score was 26.93 ± 4.64 , and maximum number of patients during 24 hours was 10, meaning that cumulative NEMS score of the whole ICU was 269.3.

It has already been shown that one nurse can process up to 45 points during 24 hours (2,13,17). Considering this on the overall ICU organization, one comes to a conclusion that at least 5.98 (6) nurses are required in order to provide adequate care to pa-

Table 2. Descriptive statistics of selected quantitative variables

	N	Mean	SD	Minimum	Maximum	Percentiles		
						25.	Median	75.
Age	265	62.82	13.38	18	92	54.50	64	73
Length of ICU stay (days)	265	2.26	2.55	1	15	1	1	2
NEMS 1	265	27.82	4.84	18	50	27	27	27
NEMS 2	98	26.34	8.72	18	50	18	25.50	33
NEMS 3	63	27.40	8.26	18	45	18	27	34
NEMS 4	41	30.34	8.10	18	50	27	27	38
NEMS 5	30	29.57	7.75	18	45	26.50	29.50	34
NEMS 6	23	28.65	7.06	18	40	25	27	34
NEMS 7	20	29.80	8.55	18	50	25.50	27	34
NEMS average of hospitalization days	265	26.93	4.64	18	45	27	27	27
CAT 1	265	58.54	4.50	32	64	56	59	62
CAT 2	98	57.59	4.89	46	64	54	58	62
CAT 3	63	58.37	5.33	44	64	55	60	63
CAT 4	41	59.24	5.49	42	64	58.50	61	63
CAT 5	30	59.37	4.66	48	64	57	61	63
CAT 6	23	59.43	4.58	49	64	57	60	63
CAT 7	20	59.70	4.44	51	64	56	61.50	63.75
Categorization score average of hospitalization days	265	57.83	4.29	44	64	55	58	62
Nurse's satisfaction with quality of care provided	265	4.28	0.50	3	5	4	4	5

tients. The number of nurses depends on the time of calculation NEMS scoring system (Figure 1).

Figure 2 shows categorization dynamics by days. Although it is similar to dynamics observed with NEMS scoring system, categorization scores are continually increasing from day 2 until day 7. Mean categorization score was 57.83 ± 4.29 . Recommended time required for providing adequate care to a single patient in category 4 during 24 hours is 10 or more hours (16). As in the description of the category 4 there is no upper limit stated on the time needed to provide adequate care for the patient, in order to calculate the required number of nurses we have established that 14 hours are needed, meaning that in order to provide adequate care to patients at least 5.83 (6) nurses are needed at the ICU. This is in line with the calculations performed using the NEMS scoring system.

Mean values of scoring systems in relation to diagnosis are presented in Table 3.

One-way variance analysis (ANOVA) showed no significant differences between diagnoses (all p values were larger than 0.05) as shown in Table 4. These results show that nursing workload in surgical intensive care units is not related to the type of surgery itself, but mostly to the ICU procedures which are non-specific.

Table 5 shows Pearson's correlation coefficients between NEMS, categorization and nurses' satisfaction with quality of provided care. Correlations between NEMS and categorization are in most cases (except for the 6th and 7th day when there were actually least participants) significant and positive, which suggests that both scoring systems address the same issue.

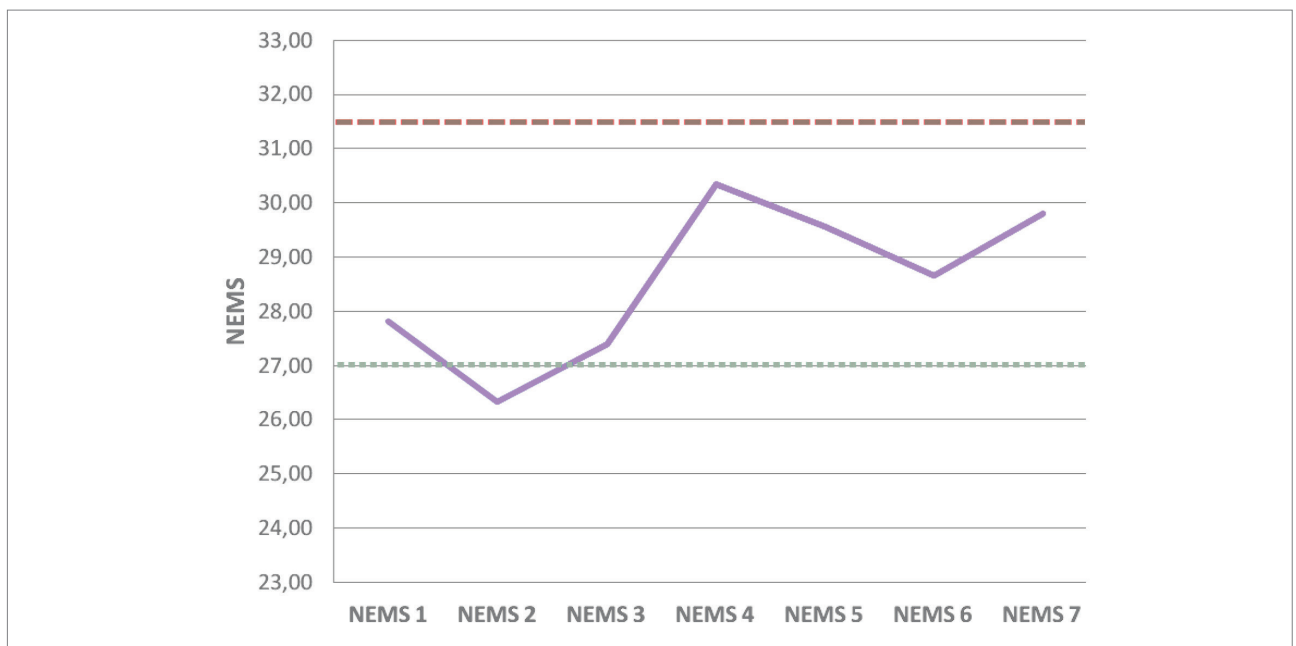


Figure 1. Dynamics of NEMS score by days

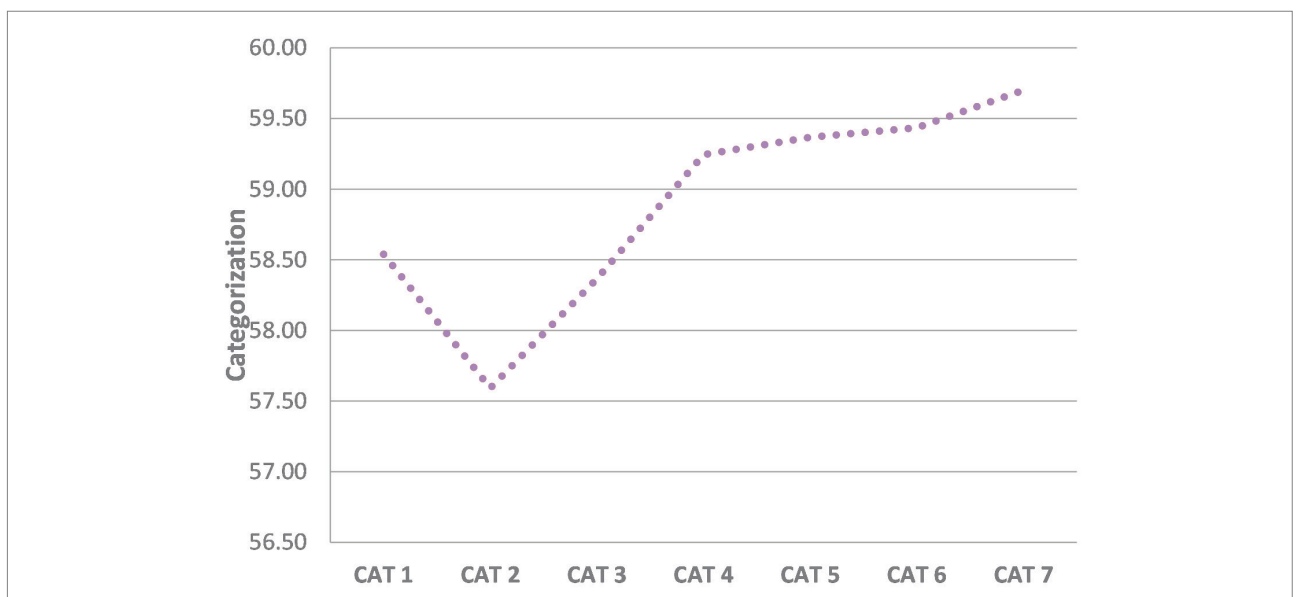


Figure 2. Categorization of score dynamics by days

Nurses' satisfaction with quality of provided care significantly negatively correlates with mean values of NEMS and categorization (higher level of satisfaction is connected with lower number of points).

Discussion

Assessment of nurses' workload is a key element in ensuring their optimal number which is a basic prerequisite for good quality of care in ICUs. Increased nurses' workload also has influence on the syndrome

Table 3. Mean values of scoring systems in relation to patient diagnosis/ ward

	N	Mean	SD	95% CI		
				Lower	Upper	
NEMS mean of hospitalization duration	Abdominal surgery	134	26.70	4.80	25.88	27.52
	Neurosurgery	64	27.91	4.44	26.80	29.02
	Thoracic surgery	23	27.73	3.11	26.39	29.08
	Maxillofacial surgery	16	26.80	2.64	25.39	28.21
	Trauma/Orthopaedics	2	31.25	18.74	-137.11	199.61
	Polytrauma	5	23.46	3.27	19.40	27.52
	Urology	20	25.02	4.65	22.84	27.19
	Plastic surgery	1	27.00			
Categorization mean of hospitalization duration	Abdominal surgery	134	57.87	4.38	57.12	58.62
	Neurosurgery	64	57.71	4.42	56.60	58.81
	Thoracic surgery	23	58.44	3.80	56.80	60.09
	Maxillofacial surgery	16	58.65	3.17	56.96	60.34
	Trauma/Orthopaedics	2	57.50	7.78	-12.38	127.38
	Polytrauma	5	57.65	3.82	52.90	62.40
	Urology	20	56.48	4.53	54.36	58.60
	Plastic surgery	1	63.00			
Nurses' satisfaction with quality of provided care	Abdominal surgery	134	4.27	0.50	4.19	4.36
	Neurosurgery	64	4.27	0.51	4.15	4.40
	Thoracic surgery	23	4.25	0.49	4.04	4.47
	Maxillofacial surgery	16	4.19	0.42	3.97	4.41
	Trauma/Orthopaedics	2	4.25	1.06	-5.28	13.78
	Polytrauma	5	4.08	0.11	3.94	4.22
	Urology	20	4.58	0.51	4.34	4.82
	Plastic surgery	1	4.00			

Table 4. ANOVA test results in comparison of average values of scoring systems in relation to patient diagnoses/wards

		Sum of squares	df	Mean square value	F	p
NEMS mean	Between Groups	254.939	7	36.420	1.725	0.103
	Within Groups	5425.681	257	21.112		
	Total	5680.619	264			
CATEGORIZATION mean	Between Groups	84.352	7	12.050	0.650	0.714
	Within Groups	4763.155	257	18.534		
	Total	4847.507	264			
Nurses' satisfaction with quality of provided care	Between Groups	2.222	7	0.317	1.282	0.260
	Within Groups	63.643	257	0.248		
	Total	65.865	264			

Table 5. Pearson's correlation coefficients between NEMS scoring system, categorization and nurses' satisfaction with quality of provided care

		NEMS 1	NEMS 2	NEMS 3	NEMS 4	NEMS 5	NEMS 6	NEMS 7	NEMS mean
Nurses' satisfaction with quality of provided care	r	-0.440**	-0.577**	-0.506**	-0.418**	-0.341	-0.281	-0.274	-0.464**
	p	<0.001	<0.001	<0.001	.007	.065	.195	.242	<0.001
	N	265	98	63	41	30	23	20	265
CATEGORIZATION 1	r	0.289**	0.354**	0.305*	0.081	-0.014	0.423*	0.500*	0.279**
	p	<0.001	<0.001	0.015	0.613	0.941	0.044	0.025	<0.001
	N	265	98	63	41	30	23	20	265
CATEGORIZATION 2	r	0.347**	0.660**	0.533**	0.150	0.223	0.259	0.046	0.595**
	p	<0.001	<0.001	<0.001	0.348	0.237	0.233	0.848	<0.001
	N	98	98	63	41	30	23	20	98
CATEGORIZATION 3	r	0.311*	0.632**	0.616**	0.154	0.425*	0.423*	0.578**	0.623**
	p	0.013	<0.001	<0.001	0.336	0.019	0.044	0.008	<0.001
	N	63	63	63	41	30	23	20	63
CATEGORIZATION 4	r	0.228	0.365*	0.380*	0.431**	0.330	0.237	0.418	0.507**
	p	0.152	0.019	0.014	0.005	0.075	0.276	0.067	0.001
	N	41	41	41	41	30	23	20	41
CATEGORIZATION 5	r	0.521**	0.362*	0.059	0.436*	0.565**	0.325	0.588**	0.584**
	p	0.003	0.050	0.757	0.016	0.001	0.130	0.006	0.001
	N	30	30	30	30	30	23	20	30
CATEGORIZATION 6	r	0.161	0.209	-0.086	-0.242	-0.160	0.566**	0.620**	0.254
	p	0.462	0.340	0.696	0.266	.466	0.005	0.004	0.242
	N	23	23	23	23	23	23	20	23
CATEGORIZATION 7	r	0.337	0.354	0.115	0.002	0.038	0.625**	0.702**	0.487*
	p	0.147	0.126	0.630	0.994	0.873	0.003	0.001	0.029
	N	20	20	20	20	20	20	20	20
CATEGORIZATION average	r	0.303**	0.614**	0.575**	0.296	0.376*	0.511*	0.658**	0.405**
	p	<0.001	<0.001	<0.001	0.060	0.041	0.013	0.002	<0.001
	N	265	98	63	41	30	23	20	265

of burnout at work and more frequent requests for transfer/ change of job (10). For that purpose, in Republic of Croatia categorization scoring system is used in order to estimate the required number of nurses in the entire hospital system, and not just in specific wards such as the ICU. In order to assess nurses' workload, in this study categorization scoring system was used along with NEMS scoring system, which is recognized globally for its simplicity and the fact that it does not require a lot of time (3).

Categorization scoring system in the assessment uses critical factors - indicators that represent activi-

ties that affect the most time needed to provide care. By use of categorization in Croatia patients are put into one of four categories depending on the level of help needed to satisfy basic human needs, as well as diagnostic and therapeutic procedures on each patient (16); however, it does not evaluate interventions which are specific for the ICU. Categorization assesses the state of each patient according to 13 factors and depending on the patient's needs, the patient is placed in a certain category on the scale of 1 to 4. Each category is scored separately and the total number of points is calculated. After this, three

additional scoring systems are used: to evaluate the state of consciousness (*Glasgow Coma Scale*), risk of falls (*Morse scale*) and risk of decubitus formation (*Braden scale*). In the ICU it is sometimes difficult to objectively assess the patient's state because most of the patients are either admitted after a major procedure or are sedated and on mechanical ventilation. Another problem in this scoring system's estimate in the ICU is the fact that the patient's condition frequently changes in the course of 24 hours, so the real question is which assessment to take into account as the relevant one. Use of this scoring system creates a significant burden in terms of the time required for the nurse in the ICU.

Unlike with categorization, NEMS uses therapeutic intervention to assess workload. It assesses nurses' workload indirectly taking into account activities performed during therapeutic interventions, not taking into account independent nurses' procedures. Today, a large number of institutions in the world uses NEMS for its simplicity and speed in scoring (13). For example, in Switzerland head nurses are motivated to ensure NEMS scoring is performed and validated (21). There are also numerous studies researching the relation of NEMS to other known scoring systems. One example of this is the study performed by Carmona-Monge and others (2013), which included a significantly higher number of patients and measurements; in other studies, assessment of nurses' workload was performed by means of NEMS scoring system and NAS (*Nursing activities score*), a scale that is used to assess activities directly connected to nurses' profession and in that aspect it was more closely related to direct patient care. In both of these variables there was a high level of correlation not just for direct measurements in each patient, but also for total measurements for patients and for total measurements on the level of the entire ICU. Besides workload, NEMS can also provide useful additional information on the severity and prognosis of the disease, and is being used in multicentric studies in ICUs, economical purposes (17) and correlates with the severity of the disease (as measured by the employment of SAPS II system) (3).

This study demonstrated moderate level of correlation between categorization and NEMS. NEMS and categorization correlations were in most cases (except for days 6 and 7 when the least number of participants was included) significant and positive, pointing towards a conclusion that both scoring sys-

tems address the same issue. Nurses' satisfaction with the level of care provided significantly negatively correlates with the means of NEMS scoring systems (higher level of nurses' satisfaction is connected with lower score values). Mean of NEMS score in the first seven days of patients hospitalized in the ICU was 26.93 ± 4.64 , whereas it reached its highest value during the 4th day (30.34 ± 8.10) after which it began to decline (Figure 2). This can be explained by the average duration of patient stay in the ICU and the fact that patients that have uneventful ICU stay (i.e. patients who had a scheduled admission) are released by the fourth day, and patients who have had complications during ICU stay (such as occurrence of VAP, anastomosis leakage or surgical wound infection) usually begin deteriorating during days 3 and 4 which requires additional diagnostic and therapeutic procedures which affect nursing workload. Cumulative NEMS of the entire department was 269.3 (10 beds) and if taken into account that a single nurse can achieve a maximum of 45 points during the course of 24 hours (2,13,17), then it is clear that, in the ICU at least, 5.98 (6) nurses are required to take adequate care of patients.

Mean categorization score was 57.83 ± 4.29 , and the highest value of categorization score was found during 7th days (59.70 ± 4.44) (Figure 3). Recommended time required for providing care to a patient in category 4 during 24 hours is 10 or more hours (16). As there is no upper limit of time required for providing care to a patient listed in category 4 description, to calculate the necessary number of nurses 14 hours were taken as the required number of hours, meaning that in order to adequately provide care to a patient at least 5.83 (6) nurses are required at the ward. This finding is in line with the finding obtained when using the NEMS scoring system.

Nurses' satisfaction with the level of care provided significantly negatively correlates with mean NEMS and categorization scores, meaning that the higher NEMS and categorization scores indicate nurses' dissatisfaction with the level of care provided. During the course of this study, during one shift in the ICU there were on average 4-5 nurses. The necessary number of nurses was calculated by using the data from both scoring systems and for NEMS this number is 5.98 and for categorization 5.8, meaning that there is a lack of 1-2 nurses in each shift.

As both categorization and NEMS scoring systems can be used for the same purpose, it is important

to take into account when deciding which scoring systems to use that NEMS scoring system requires less time to perform when compared to categorization scoring system, mainly due to the fact that it requires fewer components. The time required to perform these scoring systems is an important factor when choosing the most appropriate scoring system as nurses that provided patient care are at the same time responsible for filling out the necessary documentation to perform scoring. It has been shown that the time required to correctly record data can result in unprecisely measured data (13).

Conclusion

This study has shown moderate but significant level of correlation between categorization and NEMS scoring systems. Therefore, each of those scoring systems can be used to assess nurses' workload in the ICU. Use of both scoring systems has shown that 6 nurses are required in each shift to ensure adequate level of provided care. As both categorization and NEMS scoring systems can be used for the same purpose it is important to take into account when deciding which scoring system to use the fact that NEMS scoring system can be calculated faster than categorization. In today's society there is a clear need to categorize different types of ICUs and healthcare institutions, as well as make it possible to grade them in the total healthcare system; in this task the NEMS scoring system can be of great help.

The conclusion of this study is that NEMS scoring system is simpler, more applicable, quicker to use and more useful scoring system which should, instead of categorization scoring system, be used to assess nurses' workload in ICUs. In any case, further research is needed to further validate these results in other ICUs, as well as to determine which scoring system is the best and most useful to assess nurses' workload.

Relevance to clinical practice

Categorization scoring system for patients is a complex scoring system which uses 16 factors with three additional scales for evaluation of patient's state of

consciousness, risk of fall, and formation of decubitus, however it does not evaluate interventions that are specific for the ICU. The use of this scoring system requires significant use of nurses' time in the ICU. NEMS scoring system, on the other hand, uses 9 nurse interventions which are specific for ICUs and which have been shown to burden nurses the most, whereas the calculation itself required reasonable amount of time, approximately 1 minute per patient (3). In today's society there is a need for categorization of different ICUs and healthcare institutions and their grading in the complete healthcare system; this scoring system can help with that. For this reason, the conducted study shows the need to recognize NEMS scoring system in everyday clinical practice as a simpler, more applicable, faster and more useful scoring system in ICUs.

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PROCJENA RADNOG OPTEREĆENJA MEDICINSKIH SESTARA U JEDINICI INTENZIVNE MEDICINE PRIMJENOM BODOVNIH SUSTAVA

Sažetak

Cilj. Odrediti povezanost između dva različita bodovna sustava; kategorizacije bolesnika i Nine Equivalents of Nursing Manpower Use Score (NEMS) i njihovu sposobnost da pokažu je li broj medicinskih sestara u jedinici intenzivne medicine optimalan za pružanje kvalitetne zdravstvene njege. Utvrditi povezanost između težine stanja bolesnika i zadovoljstva medicinskih sestara kvalitetom pružene skrbi.

Metode. Istraživanje je provedeno u Kliničkoj bolnici Dubrava na Odjelu intenzivne medicine Klinike za anesteziologiju, reanimatologiju i intenzivnu medicinu u razdoblju od 8. siječnja do 14. travnja 2014. U istraživanje je bilo uključeno 265 bolesnika u dobi između 18 i 92 godine. Kategorizacija i Nine Equivalents of Nursing Manpower Use Score određivali su se svaki dan, od prvog do sedmog dana hospitalizacije u jedinici intenzivne medicine. Također su uvršteni podaci od protekla 24 sata iz medicinske dokumentacije. Nine Equivalents of Nursing Manpower Use Score računani su uz pomoć predviđene tablice i uputa za izračunavanje, a kategorizacija je unošena u elektroničkom obliku u sestrinsku dokumentaciju bolesnika. Medicinske sestre svoje su zadovoljstvo kvalitetom pružene skrbi ocjenjivale na Likertovoj ljestvici ocjenama od 1 do 5.

Rezultati. U provedenom istraživanju dokazana je visoka povezanost između kategorizacije i NEMS-a. Prosječan NEMS prvih sedam dana hospitalizacije bolesnika u jedinici intenzivne medicine iznosio je $26,93 \pm 4,64$, a najveću vrijednost je imao tijekom četvrtog dana ($30,34 \pm 8,10$), nakon čega je počeo

padati. Kumulativni NEMS cjelokupne jedinice intenzivne medicine iznosio je 269,3. U skladu s činjenicom da prema NEMS-u jedna medicinska sestra tijekom 24 sata može odraditi do najviše 45 bodova, rezultati su pokazali da je u jedinici intenzivne medicine (10 kreveta) potrebno najmanje 5,98, odnosno šest medicinskih sestara kako bi odgovarajuće zbrinule bolesnike. Prosječna kategorizacija iznosila je $57,83 \pm 4,29$, a najveća vrijednost kategorizacije je bila tijekom sedmog dana ($59,70 \pm 4,44$). Prema kategorizaciji, preporučeno vrijeme potrebno za zbrinjavanje jednog bolesnika u četvrtoj kategoriji tijekom 24 sata iznosi 10 i više sati. Budući da u opisu četvrte kategorije nije navedena gornja granica vremena potrebnog za zbrinjavanje bolesnika, za izračun potrebnog broja medicinskih sestara uzeto je 14 sati, što znači da je za odgovarajuće zbrinjavanje bolesnika prema kategorizaciji potrebno najmanje 5,83 odnosno šest medicinskih sestara na odjelu. To je u skladu s dobivenim podacima iz bodovnog sustava NEMS. Zadovoljstvo medicinske sestre kvalitetom pružene skrbi značajno negativno korelira s prosječnim bodovnim sustavom NEMS i kategorizacijom (veće zadovoljstvo medicinske sestre povezano je s nižim zbrojem bodova).

Zaključak. Svaki od navedenih bodovnih sustava može se primijeniti za procjenu sestrinskog radnog opterećenja u jedinici intenzivne medicine. Međutim, NEMS je jednostavniji, primjenjiviji, brži i korisniji bodovni sustav i trebalo bi ga, umjesto kategorizacije, primjenjivati za procjenu radnog opterećenja medicinskih sestara u jedinicama intenzivne medicine.

Ključne riječi: radno opterećenje, medicinske sestre, jedinica intenzivne medicine
