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Daily classification of the level of care. A method to describe clinical course of illness, use of resources and quality of intensive care assistance

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Abstract *Objective*: To develop a simple and comparable clinical method able to distinguish between higher and lower complexities of care in the ICU.
Design: Retrospective analysis.
Setting: Database of European ICUs Study I (Euricus-I: including 12,615 patients and 55,464 patient/days), prospectively collected in 89 ICUs of 12 European countries.
Methods and results: A panel of experts developed the classification of the complexity of care. Six (in addition to monitoring, two levels of respiratory support – *R* and *r* – two levels of circulatory support – *C* and *c* – and dialysis) out of the nine items of Nine Equivalents of Nursing Manpower use Score (NEMS), a therapeutic index, were utilised. Two levels of care (LOCs) were defined according to a more (HT) and a less complex (LT) combination of common activities of care. The two LOCs were significantly related to mortality: higher in HT and they rose with increasing cumulative number of HT days. HT accounted for 31,976 NEMS days (57.7 %) while 23,488 (42.3 %) were LT. Major respiratory and cardiovascular support accounted for about 80 % of the HT days. Respiratory assistance and monitoring were responsible for an equivalent percentage of LT days. The distribution of the clinical classification of LOCs coincided with that of the managerial scores of LOCs in the literature.
Conclusions: The managerial instrument described uses simple and reliable clinical data. It is able to distinguish between patients with different severity and outcome, and shows that every additional consecutive day spent in ICU as HT increases the probability of death. Moreover, (1) it suggests the possibility of describing the clinical course of illness by relating the complexity/level of medical care to the available technology and staff; (2) using relevant markers of clinical activity, it might be useful to include in quality control programmes.

Key words Level of care · Complexity of care · ICU · Intensive treatment · Critical length of stay · Outcome · Quality control

Introduction

The determination of levels of intensive care remains an important issue. The classification of ICUs according to four levels of care was first addressed by the Bethesda Consensus Conference (BCC) in 1981 [1]. This meeting has shown that the demands of care vary from unit to unit, and that staff requirements were the single most relevant organisational element related to the variation of demands of care.

A task force of the Foundation for Research on Intensive Care in Europe (FRICE) later revised the results of the BCC, searching for recommendations that might support the match between demands and provision of care [2]. The difference between these two studies is that the BCC recognised the (different) needs of care, whereas FRICE recommended a methodology for guiding the planning of staffing the units. Similar to the BCC study, the proposed methodology used the number of nursing staff per ICU bed for the definitions of three levels of intensive care. A task force of the European Society of Intensive Care Medicine (ESICM) [3] recently endorsed the conclusions of this study.

In the last decade, however, annual planning for the provision of resources to match the clinical demands in the ICU became a rather inadequate tool for the effective management of a unit. The current focus on the cost-effectiveness of a unit makes it necessary for real-time information to be available to the ICU manager for the frequent appraisal and guidance of resource allocation in the unit.

The present study made use of the database of FRICE, aiming at the definition of levels of daily activity of care in the ICU. The classification should enable the analysis and comparison of the daily use of resources at patient level, independent of the clinical decisions leading to their use. The classification should use elements of care readily identified by clinical and non-clinical observers.

Methods

Euricus I was a concerted action included in the Biomed-1 Programme of the Commission of the European communities (grant BMH1-CT93-1340). The study was performed in 89 ICUs (adult general, medical or surgical) of 12 European countries [4]. The present study made retrospective use of this database.

The clinical data collected in Euricus I are identified by code numbers. These numbers refer to consecutive admissions to the ICUs. The present study made use of the following data: (1) age and other demographic information, (2) severity of illness on the day of admission [5], (3) location of the patient before ICU admission (e.g. emergency, hospital ward, other ICU, operative theatre), (4) type of patient admission (medical and scheduled/ unscheduled surgical), (5) length of stay in the ICU (LOS), (6) vital status at ICU and hospital discharge. Data concerning nursing workload in relation to patient care were collected by means of the Nine Equivalents of nursing Manpower System (NEMS – Table 1) [6]. Derived from a more extensive therapeutic index [7], NEMS scores nine representative items of treatment performed on each patient in the ICU during the previous 24 h. Date and time of scoring were indicated in the scoring forms, in order for periods of time different from 24 h to be computed in a standardised fashion.

Patients with missing values and/or discharged to "other ICU", step-down units or to "other hospital" without marking the location while on the high complexity of care level were excluded from further analysis.

Table 1 Nine Equivalents of nursing Manpower use Score (NEMS) (*PEEP* positive end-expiratory pressure, *CPAP* continuous positive airway pressure, *ET* endotracheal)

1. Basic monitoring	Hourly vital signs, regular record and calculation of fluid balance
2. Intravenous medication	Bolus or continuous, not including vasoactive drugs
3. Mechanical ventilatory support	Any form of mechanical/assisted ventilation, with or without PEEP (e.g. CPAP), with or without muscle relaxants
4. Supplementary ventilatory care	Breathing spontaneously through ET tube; supplementary oxygen any method, except if (3) applies
5. Single vasoactive medication	Any vasoactive drug
6. Multiple vasoactive medication	More than one vasoactive drug, regardless of type and dose
7. Dialysis techniques	All
8. Specific interventions in the ICU	Such as ET intubation, introduction of pacemaker, cardioversion, endoscopy, emergency operation in the past 24 h, gastric lavage. The intervention/ procedure is related to the severity of illness of the patient and makes an extra demand upon manpower efforts at the ICU. Routine interventions such as X-rays, echocardiography, ECG, dressings, introduction of venous (e.g. Swan-Ganz) or arterial lines, are not included
9. Specific interventions outside the ICU	Such as surgical intervention or diagnostic procedure. The intervention/procedure is related to the severity of illness of the patient and makes an extra demand upon manpower efforts at the ICU

Table 2 Criteria patterns defining higher *(HT)* and lower *(LT)* demand-levels of care (*m* basic monitoring, *R* mechanical ventilatory support, *r* supplementary ventilatory care, *C* multiple vasoactive medication, *c* single vasoactive medication, *d* dialysis techniques)

High level of care (HT)	
Major criteria	mR, mRc, mRd, mRcd, mC, mCr, mCd, mCrd, mRC, mRCd
Additional criteria	mrc, mrd, mcd, mrcd
Low level of care (LT)	
	m, mr, mc, md, r, c, d,

Table 3 Characteristics of the case-mix (12,615 patients) (*ICU* intensive care units, *SAPS* Simplified Acute Physiologic Score, *LOS* length of stay)

Age (years)	59.1 ± 18.0
ICU admission: from (%)	
Operating theatre	36.2
Recovery room	4.1
Emergency room	31.0
Ward	16.6
Other ICU	2.0
Other	10.1
ICU admission: type (%)	
Medical	52.5
Surgical scheduled	29.9
Surgical unscheduled	15.6
SAPS II points	32.2 ± 17.1/median 29
LOS days	4.4 ± 6.6/median 2
ICU mortality %	11.3
Hospital mortality %	16.3

Development of the instrument

Under the chairmanship of one of the authors (GI), a panel of experts analysed the nine items of NEMS and their relation to severity of illness and to the complexity of scored, and non-scored but associated, care. The ultimate goal of this exercise was to establish a relationship between the complexity of care and the nursing work required (assessed by the scoring system) divided into two levels of care (LOCs): higher demands of care (HT) and lower demands of care (LT). Six NEMS items related to organ failure support were chosen for classifying each ICU day into one of two mutually exclusive complexities/levels of care: items 1, and 3–7 in Table 1 (Table 2). The classification into two levels of care was felt to incorporate the definition of the three levels of care described by the FRICE [2] and later adopted by a task force of the ESICM [3].

1. The category HT is defined by item 1 (monitoring – *m*) together with at least one of the following: (i) item 3 (mechanical ventilation support/continuous positive airway pressure (CPAP) –*R*) and/or (ii) item 6 (multiple vasoactive medication – *C*). The resulting combination of items (criteria pattern), *mR*, *mC* or *mRC* were called major HT criteria (invasive and active support of organ dysfunction, utilising advanced technology).

   The category HT can also be defined by item 1 *(m)* together with a combination of other items: (i) item 4 (supplementary ventilatory care – *r*) + item 5 (single vasoactive medication – *c*), (ii) item 4 *(r)* + item 7 (dialysis – *d*) or (iii) item 5 *(c)* + item 7 *(d)*. The resulting criteria patterns, *mrc, mrd, mcd, mrcd* were called additional HT criteria (moderate invasive support of at least two organs). By itself, dialysis was not considered a major HT criterion (it can be applied outside the ICU). The category HT includes LOCs II and III of the classification of ICUs according to FRICE [2].
2. The category LT is defined by the combinations of patterns not included in HT, such as: *m, r, rm, c, cm, d, dm*, including also the absence of score in any of the items of NEMS. This LT category corresponds to LOC I [2, 3].

Covering periods of 24 h, this classification into two LOCs allows for the identification of the consecutive number of days of care in which a HT was provided (LOSc).

Testing the new instrument

The reliability of the score (the extent to which repeated measurements of an unchanged characteristic provide the same results) had already been assessed [6]. The validity (the extent to which the instrument measures what it is intended to measure) was tested in relation to both content/face and criterion-related validity.

A panel of experts certified face validity. An external committee of Euricus-involved experts then evaluated their proposal. The criterion-related validity is the assessment of the relationship between the instrument and an outside indicator of the phenomenon to be measured. Since there is no gold standard method to assess the LOC, the criterion-related validity cannot be directly assessed. Our investigation of this validity relies, therefore, upon the expected association between measured LOC and mortality. That is, the ICU/hospital mortality among the patients with HT versus patients who scored exclusively LT and mortality among criteria patterns defining HT demands of care for admission day and LT for the whole LOS.

Statistical analysis

Data are reported as means ± standard deviation. Student's *t* test-Bonferroni procedure, one-way variance analysis, χ^2 test, Cochrane-Mantel-Haenszel χ^2 test for mortality rate comparison and least square method for regression analysis with natural logarithm transformation were used.

Results

After exclusion criteria were applied, data from 12,615 patients were used in the analysis. The general characteristics of the patient population are presented in Table 3. Of the 55,464 NEMS records analysed, 31,976 (57.7 %) corresponded to higher demand of care (HT) and 23,488 (42.3 %) to lower demand of care (LT). Major HT criteria classified 84.9 % of HT days. Considering major and additional HT criteria together, *R* accounted for 58.8 %, *RC* for 20.1 %, *r+c* 14.3 % and *C* for 6.0 %. Mechanical ventilation/CPAP was applied on 78.9 % of HT treatment days. LT criteria: *r* ± *m* classified 58.9 % of LT days, *m* alone 30.5 %, *c* ± *m* 8.7 %, no procedure 1.5 %, *d* ± *m* 0.6 %. The outcome of 5,424 patients receiving only LT was significantly differ-

Table 4 Results of patients receiving only low level treatment *(LT)* and patients receiving at least 1 day of intensive treatment during length of stay *(HT)*. Intensive care unit (ICU)/hospital mortality in LT patients versus HT patients: χ^2 test, $p < 0.001$

	Patients	ICU deaths	Mortality %	Hospital deaths	Mortality %
LT treatment	5,424	97	1.8	309	5.7
HT treatment	7,191	1,332	18.5	1,746	24.3

Table 5 Patient sub-sets selected by high level treatment *(HT)* criteria on admission day and low level treatment *(LT)* during the whole ICU stay (*m* basic monitoring, *R* mechanical ventilatory support, *r* supplementary ventilatory care, *C* multiple vasoactive medication, *c* single vasoactive medication, *d* dialysis techniques (Fig. 1))

HT criteria patterns[a]	Patients	ICU deaths	ICU mortality (%)	SAPS II[b]	Observed/expected hospital mortality values and relative ratio[c]	
1. mRC	1,244	430	34.6	47.1 ± 20.7/45	40.5/41.0	0.99
2. mRc, mRcd	1,750	380	21.7	40.3 ± 16.9/37	27.5/30.4	0.91
3. mrC, mrCd	370	70	18.9	34.7 ± 13.7/33	26.5/20.9	1.27
4. mR, mRd	1,822	227	12.5	35.6 ± 16.0/28	18.7/23.9[d]	0.78
5. mC, mCd	97	8	8.3	29.5 ± 9.0/33	14.4/12.9	1.12
6. mrc, mrcd	1,388	104	7.5	30.3 ± 11.6/29	12.2/15.1[e]	0.81
Total	6,671	1,219	18.3	37.7 ± 17.2/34		
LT Criteria patterns[g]						
7. r, mr	3,039	49	1.6	24.9 ± 11.7/24	6.4/10.2[d]	0.63
8. c, mc	439	12	2.7	27.1 ± 10.9/27	5.5/11.2[f]	0.49
9. Other	1,946	36	1.9	22.7 ± 11.5/21	4.6/8.5[d]	0.54
Total	5,424	97	1.8	24.3 ± 11.7/23		

[a] HT criteria: for the sake of simplicity (6 sets of HT criteria instead of 12), patients whose HT criteria were dependent upon dialysis (26 rd and 2 cd combinations) were excluded from the analysis. All other first HT days positive for dialysis: 14 (Rd), 11 (Cd), 21(rcd), 23 (Rcd) and 8 (Crd) remain HT even without considering dialysis

[b] Simplified Acute Physiologic Score (SAPS II) mean ± SD/median points. All mean SAPS II scores are different (*t* test Bonferroni procedure: $p < 0.001$) from all the others but 3 versus 5 and 5 versus 8

[c] Hospital mortality: observed versus SAPS II-expected values comparison (χ^2 test: $p < 0.001^d$, $p < 0.05^f$, $p < 0.01^e$).

[g] LT criteria: We pooled the small number of dialysis patients (md, d: 22) and 74 patients without procedures together with 1,850 patients with only monitoring in the same group (Other)

ent from that of 7,191 patients who received HT during at least part of their stay in the ICU (Table 4).

The demands of care (expressed in nine categories) on the day of admission associates significantly with the outcome of the patients (Table 5). Controlling for the vasoactive item, (for example, *zero, c, C*), higher ventilatory support was associated with a significant increase in mortality. There was a significant positive association between the two variables in determining ICU/hospital mortality (Cochrane-Mantel-Haenszel χ^2, $p < 0.001$).

Considering the various HT and LT demands of care defined by the proposed classification, each of them associates with a SAPS II score that is significantly different from the scores of the other levels of demand of care (*t* test with Bonferroni procedure), except for *mrC* versus *mC* and *mC* versus *c* ± *m*. SAPS II significantly overestimates the risk of hospital death in *R* and *rc* criteria and in all three LT criteria subsets. The number of consecutive days with a HT demand of care (patients with more than one period of LOSc were ranked according to the longer period) was significantly associated with ICU/hospital mortality (Table 6). Figure 1 shows the cumulative ICU and hospital mortality for all lengths of LOSc.

Discussion

Complexity of medical care in ICU patients is usually assessed on the day of admission, taking into account the severity of illness, reason for admission and nursing workload [8, 9, 10].

This study proposes the classification of the daily activities in the ICU into two levels of complexity of care. They consist of a total of 21 different patterns of demands of care identified by only six items (Table 2). HT LOC, in particular, spans from mechanical ventilation support/CPAP and multiple vasoactive medication *(RC)* to supplementary ventilatory care and single vasoactive medication *(rc)*, comprising a wide range of demands of care. Treatment was classified as intensive either in cases of invasive/active support for respiratory or circulatory acute failure (major criteria), or in cases of less invasive support of the same functions or dialysis, when at least two

Table 6 ICU/hospital mortality variations increasing consecutive days with high complexity/level of intensive treatment (LOSc) (χ^2 test: $p < 0.001$) in 7,191 patients with intensive treatment

LOSc days	Patients	ICU mortality (%)	Hospital mortality (%)
1	2,921	11.7	15.9
2	1,467	11.5	16.6
3	660	18.8	27.7
4	427	21.5	28.3
5	288	27.8	35.1
6	227	28.6	35.2
7	163	31.3	42.3
8	136	31.6	37.5
9	107	28.0	39.3
10	96	33.3	37.5
11	75	37.3	38.7
12	57	26.3	33.3
13	66	36.4	48.5
14	56	42.9	50.0
15	48	41.7	47.9
16	42	40.5	42.9
17	36	38.9	44.4
18	27	51.9	55.6
19	38	47.4	63.2
20	33	54.5	63.6
> 20	221	50.7	59.3

of these treatments were performed (additional criteria). Major failures of other important organs (e.g. brain, liver, etc.) were not considered directly.

One of the strengths of the methodology used is that it applies six of the nine items used to quantify nursing workload in the ICU. In other words, the proposed methodology explores the link between a score measuring nursing workload (NEMS) and a small set of common activities in the care of ICU patients. Because it is based on clinical judgement and experience, the classification (including the activities and their associations) is readily recognised and meaningful to ICU professionals. Moreover, because it is very simple and can be performed with a quick glance on the clinical data sheet, it guarantees repeatability and consistency.

In our study, about 60 % of the ICU bed capacity was allocated to the 'higher level of complexity' of care (HT). Conversely, 40 % of the ICU bed capacity was dedicated to the 'lower level of complexity' of care (LT). Even if, according to personnel and the availability of advanced technology, not all ICU beds were equipped to provide high LOC (as defined elsewhere [4]), these data could indicate a certain degree of inappropriateness in the use of high-facility beds. Anyway, we know that patients recently weaned from invasive/active procedures often need LT LOC before safe discharge to the ward. Hence, we carried out a sensitivity analysis by considering the first LT day after a day fulfilling major HT criteria as a functional HT day. Even with such a reasonable "clinical increase" of high LOC (2,398 LT days out of 2,165 patients), we failed to show a significant increase in the high-LOC rate (from 57.7 to 62.0 %). These results are important, as they coincide with the classification of three levels of care proposed by FRICE and the ESICM. In a study recently published [4], the bed capacity of the two more complex levels of care (levels II and III), measured by the NEMS score in terms of nursing workload, totalled about 65 %.

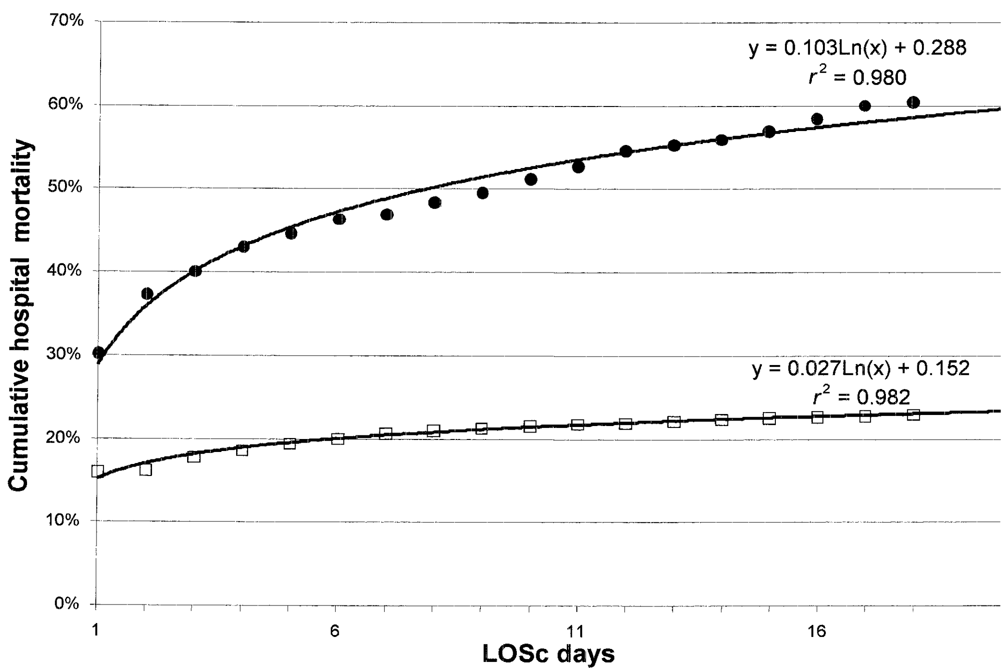

Fig. 1 Cumulative hospital mortality for all periods in which high level of care was consecutively provided (LOSc). For every day of LOSc 7,191 patients were analysed. *Open squares* in the lower line represent cumulative mortality of all the patients with LOSc up to and including the present day. *Full circles* in the upper line represent cumulative mortality of all the patients with higher LOSc. Cumulative ICU mortality (data not presented) follows the same trend, respectively: y = 0.022Lnx + 0.107, $r^2 = 0.967$; y = 0.097Lnx + 0.218, $r^2 = 0.988$

As might be expected, we found that HT, as compared to LT, was associated with a risk of mortality 10 times higher in ICU and 5 times higher in the hospital, after discharge from the ICU (Table 4). These differences were also consistent for all sub-sets of treatment considered on the day of admission (Table 5). Moreover, a significant positive association of respiratory and/or circulatory support level and mortality was found. The number of consecutive HT days also had a significant impact on the outcome: after the 3rd day of stays in the ICU, the longer the HT period (LOSc), the higher the mortality (Table 6). The correlation between LOC and severity is not surprising because SAPS II uses information captured by LOC. Anyway, SAPS II does not score supplementary ventilatory assistance (Table 5) and does not take into account the number of vasoactive drugs used. Interestingly enough, SAPS II significantly overestimates hospital mortality in *R* and *rc* as well as in all LT demands of care. This overestimation involves about 70 % of all patients.

A marker of the resources utilised to treat the observed case-mix is provided by HT and LT treatment days in a single ICU. This information allows us to check the appropriate use of resources according to the availability of personnel and advanced technology i.e. operating high- and low-facility beds. It also allows for the planning of the best organisation of intensive medicine, e.g. more/less beds, separate intensive and intermediate units versus a single "mixed" ICU [11]. Moreover, LOSc instead of a more detailed description of the clinical course of illness could be a marker of demand for intensive assistance and quality of care.

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References

1. Consensus Conference (1983) Critical care medicine. JAMA 250: 798–804
2. Miranda DR, Langrehr D (1990) National and regional organisation. In: Miranda DR, Williams A, Loirat P (eds) Management of Intensive Care. Guidelines for better use of resources. Kluver, Dordrecht Boston London, pp 83–102
3. Ferdinande P, Task Force of the European Society of Intensive Care Medicine (1997) Recommendation on minimal requirements for Intensive Care Departments. Intensive Care Med 23: 226–232
4. Organisation and management of intensive care. A prospective study in 12 European countries (1998) Reis Miranda D, Ryan DW, Schaufeli WB, Fidler V (eds). Springer, Berlin Heidelberg
5. Le Gall JR, Lemeshow S, Saulnier F (1993) A new simplified acute physiology score (SAPS II) based on a European-North American multicenter study. JAMA 270: 2957–2963
6. Miranda DR, Moreno R, Iapichino G (1997) Nine Equivalents of nursing Manpower Score (NEMS). Intensive Care Med 23: 760–765
7. Miranda DR, De Rijk A, Schaufeli W (1996) Simplified Therapeutic Intervention Scoring System: the TISS-28 items – results from a multicenter study. Crit Care Med 24: 64–73
8. Oye RK, Bellamy PE (1991) Pattern of resource consumption in medical intensive care. Chest 99: 685–689
9. Keenan SP, Doig GS, Martin CM, Inman KJ, Sibbald WJ (1997) Assessing the efficiency of the admission process to a critical care unit: does the literature allow the use of benchmarking? Intensive Care Med 23: 574–580
10. Zimmerman JE, Wagner DP, Sun X, Knaus WA, Draper E (1996) Planning patient services for intermediate care units. Crit Care Med 24: 1626–1632
11. Vincent JL, Burchardi H (1999) Do we need intermediate care units? Intensive Care Med 25: 1345–1349