Chapter 18
Nurse Staffing Levels: Skill Mix and Nursing Care Hours Per Patient Day

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18.1 Introduction

Nursing workload (patient care commitment) is a relevant part of the nursing care routine, significantly affecting the quality of care and the goals of nursing care plans. As a term, "nursing workload" (NW) has often been used in scientific literature, but frequently without a real reference background [1]. Many authors throughout the years have suggested possible definitions, according to development of the nursing professional's role and nursing theoretical principles. In the past, NW concept was just patient-related tasks (nursing care and bedside activities) in connection with the time spent to carry out these activities. Recently, the same NW concept has been reviewed including the time spent by nurses to perform non-patient-related tasks (or bedside cares) such as continuing educations, clinical updates, and management processes [2]. Several authors have outlined that NW concept is not merely based on the physical efforts to perform nursing care, but as a comprehensive part of high-dependency patient care, it should consider the

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reflection process, urging time of maneuvers, and the related emotional involvement [3].

Lately also nursing managers and researchers have shown interest about new potential ways to define and measure NW concept. Researchers have investigated the relationship between clinical data and the events in order to improve quality and safety; on the other hand, nurse management is motivated and focused to find out tools and strategies able to promote the best use of nurse staff resources.

Most of the time, the existing relationship between financial budget cost, limited resources, and clinical/staff achievements has been analyzed by scientific literature. It is well recognized that there is a direct relation between patient's outcomes and nursing staff levels: (understaffing with) high level of NW score produces an increase of mortality rate [4, 5], potential complications, and adverse events [6, 7]. From a nursing staff perspective, it could lead to potential job decline due to frustration or professional burnout phenomenon [4, 8, 9].

However, it is crucial to bear in mind that nursing staff represents the largest amount of professionals inside hospitals, and from a personnel-budget point of view, it remains one of the main cost items [2]. So, planning and matching the right amount of nurse staffing is a key point to provide the best cost-effective quality and safety of care.

Introducing tools to measure the NW can help in supporting the decision-making process with the latest evidence available, thus getting the best resources' efficiency. Nevertheless, understanding and evaluating the NW concept appears to be complex and difficult [10].

Patient-specific nursing care, severity of illness, complexity of techniques, and the wide range of fields where nursing care is provided show only a part of the issues involved in the NW's evaluating process. Several methods and tools have been devel-

oped according to specific features and approaches related to specific fields of work.

In the critical care setting, it is essential to evaluate the intensity of care, in order to provide adequate levels of care for high-dependency patients and to justify the high costs of human and technological investments. Since the early 1970s, inside ICUs, tools and procedures were tested and improved according to the evolution of clinical, technological, and organizational dimensions and the evolving nursing role. The new contest of limited financial resources for health-care providers requires to correctly estimate the right amount of nursing staff through correct tools.

When comparing all the available options in literature, the nursing activities score (NAS) seems to be the most useful tool across European ICUs [11–15] and worldwide [16].

18.2 Nursing Activities Score (NAS)

NAS [1] was developed on a basic principle: nursing care is not defined only by the gravity of illness and therapeutic procedures. This tool was realized from the basics of TISS 28 score [17]. Compared to TISS 28, NAS' authors have pointed out the real-time evaluation of this tool, expression of the time taken to administer ICU's patient care. NAS' score is made up of 13 main areas (parts), split into 23 items (Table 18.1), able to describe patient-related and non-patient-related works, administrative tasks, and level of patient's dependency as well. The resulting score, worked out by percentage, represents the total amount of time required to deliver nursing care. A NAS score of 100% corresponds to one nurse dedicated to a single patient over 24 h (nurse-to-patient ratio 1:1 equal to 1440 min of nurs-

Table 18.1 Nursing activities score: interventions and attributed weights

Basic activities	Score
1. **Monitoring and titration**	
1.a Hourly vital signs, regular registration, and calculation of fluid balance. Patients who require **NORMAL** monitoring, according to the ICU routine application of assessment scales (pain, RASS, Glasgow), and water balance control (including nasogastric and nasoenteral tubes) and who do not need frequent alterations in treatment, therapy, or monitoring intensification. Assisted oral feeding	4.5
1.b Present at bedside and continuous observation or active for 2 h or more in any shift, for reasons of safety, severity, or therapy, such as noninvasive mechanical ventilation, weaning procedures, restlessness, mental disorientation, prone position, donation procedures, preparation and administration of fluids and/or medication, and assisting specific procedures. Patients who require intensified monitoring (MORE THAN NORMAL) due to alterations in the clinical condition, hemodynamic instability, oliguria, bleeding, dyspnea, fever, alteration in the level of consciousness, measurements in the assessment scales higher than the ICU standard, measurement of central venous pressure, invasive arterial pressure, intra-abdominal pressure, use of sedatives or long-term use of insulin, ventilator support, noninvasive mechanical ventilation or alteration of the ventilator parameters, preparation of fluids, and emergency medication. Patient is stable after the therapeutic behavior adopted. Immediate postoperative care after cardiac surgery or major surgery, where the patient remains stable. Invasive procedures with intercurrences. Extubation without intercurrences. Assisted oral feedings that demand more time than normal	12.1

Table 18.1 (continued)

Basic activities	Score
1.c Present at bedside and active for 4 h or more in any shift for reasons of safety, severity, or therapy, such as those examples above (1b). Critical patients who require MUCH MORE THAN NORMAL monitoring, in at least one shift in 24 h, without stabilization after the therapeutic interventions were adopted, require continuous nursing presence. Alterations described in the "MORE THAN NORMAL" category, however, with a greater frequency and the need for interventions. Hemodialysis with intercurrence, requiring nursing intervention (when hemodialysis is performed by ICU staff). Unstable patients in immediate postoperative care after cardiac surgery or major surgery	19.6
2. Laboratory: Biochemical and microbiological investigations. Patients submitted to any biochemical or microbiological exam, regardless of the quantity, performed at bedside by a nursing professional, including capillary glucose. For example, HGT, glycosuria, tracing cultures, and blood gas analysis, among others. This item should not be scored if the laboratory collector or physician performs the collection	4.3
3. Medication. Vasoactive drugs excluded. Patients who received any type of medication, regardless of the route and dose. Vasoactive drugs will be scored in a specific item (item 12)	5.6
4. Hygiene procedures. Performing hygiene procedures such as dressing of wounds and intravascular catheters, changing linen, washing patient, incontinence, vomiting, burns, leaking wounds, complex surgical dressing with irrigation, special procedures (e.g., barrier nursing, cross-infection related, room cleaning following infections, staff hygiene) and especially obese patients, etc.	
4.a **Normal.** Patients who were submitted, in **NORMAL** frequency (ICU routine), to one of the hygiene procedures mentioned above in at least one shift in 24 h. Also including dressings closed in vascular catheter once a day	4.1

(continued)

Table 18.1 (continued)

Basic activities	Score
4.b **The performance of hygiene procedures took more than 2 h in any shift.** Patients who were submitted, in **MORE THAN NORMAL** frequency, to one of the hygiene procedures mentioned above in at least one shift in 24 h. Vascular catheter dressing twice a day, medium dressing for pressure ulcer, dressing a surgical incision twice a day, medium dressing (with suture dehiscence), changing linen twice in 24 h, washing of unstable patients by three professionals, body hygiene twice per shift. Fecal incontinence three times a day. Patients in isolation	16.5
4.c **The performance of hygiene procedures took more than 4 h in any shift.** Patients who were submitted, in **MUCH MORE THAN NORMAL** frequency, to one of the hygiene procedures mentioned above in at least one shift in 24 h. Extensive, complex, open cavity dressing for ≥three times a day	20.0
5. Care of drains: All (except gastric tube). Patients with any type of drain or tube with the aim of draining. Including long-term catheter, external ventricular drain (EVD), and thorax drain, among others. EXCLUDING gastric tubes (nasogastric, nasoenteral, gastrostomies, and others), which should be considered in item 1 or 21	1.8
6. Mobilization and positioning. Including procedures such as turning the patient, mobilization of the patient, moving from bed to chair, and team lifting (e.g., immobile patient, traction, prone position)	
6.a **Performing procedure(s) up to 3 times per 24 h.** Patients who require mobilization and positioning up to three times in 24 h	5.5
6.b **Performing procedures(s) more frequently than 3 times per 24 h, or with 2 nurses—any frequency.** Patients who require mobilization and positioning, as described in item 6, which have been performed more than three times in 24 h or by two members of the nursing staff in at least one shift in 24 h	12.4

Table 18.1 (continued)

Basic activities	Score
6.c **Performing procedure with three or more nurses—any frequency.** Complex mobilization and positioning as per the procedure described in item 6, which have been performed by three or more members of the nursing staff, in any frequency, in at least one of the shifts in 24 h	17.0
7.0 **Support and care of relatives and patient**. Including procedures such as telephone calls, interviews, and counseling. Often, the support and care of either relatives or patient allow staff to continue with other nursing activities (e.g., communication with patients during hygiene procedures, communication with relatives while present at bedside and observing patient)	
7.a **Support and care of either relatives or patient requiring full dedication for about 1 h in any shift such as explaining clinical condition and how to deal with pain and distress and difficult family circumstances**. This item receives a score when guidance or instructions are given to patients and/or their families, providing emotional support with full dedication of a nurse from the staff, with **NORMAL** duration, according to the routine established in the unit, in at least one shift in 24 h	4.0
7.b **Support and care of either relatives or patient requiring full dedication for 3 h or more such as explaining clinical condition and how to deal with pain and distress and difficult family circumstances.** This item receives a score when guidance or instructions are given to patients and/or their families, providing emotional support with full dedication of a nurse from the staff, with **MORE THAN NORMAL** duration, according to the routine established in the unit, in at least one shift in 24 h	32.0
8. **Administrative and managerial tasks**	
8.a **Performing routine tasks such as processing of clinical data, ordering examinations, and professional exchange of information (e.g., ward rounds).** Including records performed as nursing process and/or shift change, multidisciplinary rounds, or administrative and managerial tasks related to patients, with **NORMAL** duration	4.2

(continued)

Table 18.1 (continued)

Basic activities	Score
8.b **Performing administrative and managerial tasks requiring full dedication for about 2 h in any shift such as research activities, protocols in use, admission, and discharge procedures**. Including records performed as part of nursing process and/or shift change, multidisciplinary rounds, or administrative and managerial tasks related to patients, with **MORE THAN NORMAL** duration. Admission of patients in immediate postoperative period, unstable patients who require more extensive records. Need for providing materials and equipment. Assembly of the hemodialysis machine, application of protocols such as ECLS, transplantation, and others. When the nurse needs help from a colleague to perform his/her activities. For example, the nurse continues assisting a patient and a colleague takes over the administrative tasks	23.2
8.c **Performing administrative and managerial tasks requiring full dedication for about 4 h or more of the time in any shift such as death and organ donation procedures and coordination with other disciplines.** Including any administrative and managerial task related to the patient, with **MUCH MORE THAN NORMAL** duration, according to the routine established in the unit. Critical, unstable patients who require intense records. Detailed shift change records, multidisciplinary rounds, organization of special materials and equipment for patient care, surgical procedures at bedside, protocols such as transplantation, ECLS, ventricular assist devices, and teaching and supervising education/training	30.0
Ventilatory support	
9. Respiratory support. Any form of mechanical ventilation/ assisted ventilation with or without positive end-expiratory pressure, with or without muscle relaxants; spontaneous breathing with positive end-expiratory pressure (e.g., CPAP or BiPAP), with or without endotracheal tube; and supplementary oxygen by any method. Patients making use of any respiratory support, from nasal catheter to mechanical ventilation	1.4

Table 18.1 (continued)

Basic activities	Score
10. **Care of artificial airways**. Endotracheal tube or tracheostomy cannula. Patients making use of orotracheal or nasotracheal tube or tracheostomy	1.8
11. Treatment for improving lung function. Lung physiotherapy, incentive spirometry, inhalation therapy, and intratracheal suctioning. Patients who underwent treatment to improve their pulmonary function, performed in any frequency by the nursing staff. Aspiration with open or closed system and nebulization	4.4
Cardiovascular support	
12. Vasoactive medication, irrespective of type or dose. Patients who have received any vasoactive medication, regardless of the type and dose and who need intensive monitoring in their endovenous use: sodium nitroprusside, vasopressin, prostaglandin, norepinephrine, epinephrine, dopamine, dopexamine, dobutamine, isoproterenol, phenylephrine, nitroglycerin, and clonidine hydrochloride. Metoprolol and propranolol (beta blockers) should be scored	1.2
13. Intravenous replacement of large fluid losses. Fluid administration > 3 l/m2/day, irrespective of type of fluid administered. Patients who have received fluid replacement greater than 4.5 liters of solution per day, irrespective of the type of fluid administered	2.5
14. Left atrium monitoring. Pulmonary artery catheter with or without cardiac output measurement. Patients making use of pulmonary artery catheter (Swan-Ganz catheter). Including the use of cardiac pacemaker, intra-aortic balloon pumping, cardiac output monitoring, extracorporeal life support (ECLS), and ventricular assist devices	1.7
15. Cardiopulmonary resuscitation after arrest: in the past 24 h (single precordial thump not included). Patients who suffered a heart problem and were submitted to cardiopulmonary resuscitation, independently of the environment where the cardiac arrest took place. This item should be scored only once in 24 h	7.1

(continued)

Table 18.1 (continued)

Basic activities	Score
Renal support	
16. Hemofiltration techniques. Dialysis techniques. Patients who have received any type of intermittent or continuous dialytic procedure	7.7
17. Quantitative urine output measurement (e.g., by indwelling urinary catheter). Patients who require diuresis control, in milliliters, with or without any type of urinary device	7.0
Neurological support	
18. Measurement of intracranial pressure. Patients submitted to intracranial pressure monitoring, jugular bulb catheter, or microdialysis. Do consider this item if the patient has external ventricular drainage and assessment of ICP	1.6
Metabolic support	
19. Treatment of complicated metabolic acidosis/alkalosis. Patients who made use of specific medication to adjust metabolic acidosis or alkalosis, such as administration of sodium bicarbonate in continuous or bolus infusion. Respiratory acidosis and alkalosis should not be scored in this item, and neither should ventilator correction. The item considers those conditions requiring the permanent presence of a nurse for monitoring severe physiological deregulation and for titrating (fine-tuning) the therapy in acute conditions. During hemofiltration, if correction is necessary, additional score is indicated	1.3
20. Intravenous hyperalimentation. Patients who receive central or peripheral venous infusion of parenteral nutrition	2.8
21. Enteral feeding. Through gastric tube or other gastrointestinal routes (e.g., jejunostomy). Patients who receive enteral feeding through tubes, by any route of the gastrointestinal tract. Measurement of aspiration/retention included	1.3

Table 18.1 (continued)

Basic activities	Score
Specific interventions	
22. Specific intervention(s) in the intensive care unit. Endotracheal intubation, insertion of pacemaker, cardioversion, endoscopies, emergency surgery in the past 24 h, and gastric lavage. Routine interventions without direct consequences for the clinical condition of the patient, such as X-rays, echography, electrocardiogram, dressing, or insertion of venous or arterial catheters, are not included. Patients submitted to a diagnostic or therapeutic intervention listed above in the ICU. Specific procedures performed in the unit and which require active intervention of the staff can be considered in this item, including the insertion of venous or arterial catheters and spinal puncture. Procedures performed by the nurse, such as passing a relief or indwelling urinary catheter, a nasoenteral or gastric tube, or a peripherally inserted central catheter (PICC) and installation of intra-abdominal pressure, among others, that might be particularly complex and require more nursing time for their execution can also be considered	2.8
23. Specific interventions outside the intensive care unit. Surgery or diagnostic procedures. Patients who require diagnostic or therapeutic interventions performed outside the ICU. For example, tomography, radionuclide imaging, magnetic resonance, hemodynamics (take or pick up a patient), surgical procedures (take or pick up a patient), patient transfer to any hospitalization unit or discharge, and sending the body to the morgue	1.9

ing care). The NAS average value for an ICU will determine the level of workload of the nursing staff.

This validation study involved 15 countries, 99 ICUs from Europe, the North American region, and Australia. In the first stage, a survey was submitted to ICU nurses and doctors, to find out what kind of items should have been considered; after this step, a wide validation process was performed. Research was focused on two main targets: to evaluate the relationship

between TISS-28 and NAS and to analyze the way of employ of nursing care timing in the ICU setting (comparison of each item versus total score). The time spent to deliver nursing care was investigated by a registration method and then classified depending on (1) the amount of time to deliver patient-related care; (2) non-patient-related activities, e.g., management tasks; (3) supporting the staff's requirements; and (4) every kind of activity not previously mentioned.

According to point (1), collection of data has shown as follows: using 6.451 data that were collected (2041 patients recruited), the average TISS-28 value was 26.9 (SD ± 9.9), with median value (the middle of the distribution) of 27, whereas mean NAS value was 56 (SD ±17.5), with median value of 54. The correlation TISS-28-NAS was 0.56 ($r = 0.56$–$p < 0.001$).

With reference to point (2), results have shown as follows: the tool's reliability to describe/define NW was 81% of the total amount of time spent to deliver nursing care, while the 11% of it was referred to non-patient-care-related activities, 6% was referred to personal activities, and only 2% wasn't recognized by the aforementioned categories.

A literature review [18] outlined that NAS score has been investigated on different levels of dependency (ITU, HDU) and different fields (adult, pediatric, neonatal), despite the tool being tailored for adults only. So far, the use of NAS in ICU for its accuracy is supported by scientific literature [14, 19]. In the last decade, NAS became the first choice to evaluate and analyze NW inside ICUs; however, Goncalves et al. outlined several limitations due to potential misinterpretations of the items [20]. Table 18.2 summarizes the results concerning the mean values of NAS in the studies of the past 10 years.

Table 18.2 Key studies on nursing workload

Author, year	Pts	NAS sheets	Setting (type of ICU)	NAS (MD ± SD)	Ideal N/P ratio (NAS/100)
Adell et al. [21]	250	1880	GICU	41(13)	0.4
Altafin et al. [19]	437	ns	GICU	75(9)	0.7
Camuci et al. [22]	50	1221	Burns ICU	70(ns)	0.7
Carmona-Monge et al. [23]	103	941	GICU	55(15)	0.5
Carmona-Monge et al. [24]	563	5704	MICU	53(ns)	0.5
Oliveira et al. [25]	190	ns	GICU	58(3)	0.6
Nogueira De Souza et al. [26]	600	ns	GICU	68 and 53	0.7 and 0.5
Debergh et al. [27]	155	1280	GICU, PICU	55	0.5
Lucchini et al. [12]	250	ns	GICU	76 (15)	0.7
Lucchini et al. [7]	240	ns	GICU	82 (9)	0.8
Lucchini et al. [28]	200	ns	GICU	74 (9)	0.7
Lucchini et al. [14]	5856	28,390	GICU, CICU, NICU	66 (2)	0.7
Lucchini et al. [29]	7588		GICU, CICU, NICU	62(19)	0.6
Nogueira et al. [30]	200	200	Trauma ICU	71 (17)	0.7
Padilha et al. [31]	200	200	GICU, NICU	73 (14)	0.7
Padilha et al. [32]	68	690	GICU	64 (2)	0.6
Queijo et al. [33]	100	ns	GICU, CICU, NICU	65 (7)	0.7
Stafseth et al. [13]	235	ns	GICU	96 (22)	0.9

CICU cardiosurgical intensive care unit, *GICU* general intensive care unit, *MICU* medical intensive care unit, *NICU* neurosurgical intensive care unit, *PICU* pediatric intensive care unit

18.3 Determining Factors in ICU Nursing Workload

Available studies evaluated the possible determinants of the NW in the ICU. The main factors can be summarized as follows:

- Sociodemographic characteristics
- Clinical features
- Therapeutic treatments
- Clinical trials

Tables 18.3 and 18.4 summarize the impact of these factors on the NW.

Table 18.3 Sociodemographic characteristics and nursing workloads

Author, year	Factors related to the NW	Factors NOT related to the NW	Sample/ surveys	ICU type
Altafin et al. [19]		Age ($p = 0.754$) Gender ($p = 0.68$)		M/S ICU
Nogueira et al. [26]		Age ($p = 0.749$)	$n = 187$	CICU
Nogueira et al. [30]	↑ Male gender ($p = 0.033$)		$n = 200$	GICU
Lucchini et al. [14]	↑ Age 0–10 ($p < 0.05$, children have a higher NAS)		$n = 5856$	GICU, CICU
Queijo et al. [33]	↓ Inverse correlation with age ($p = 0.035$)		$n = 100$	NICU

M/S ICU medical/surgical intensive care unit, *CICU* cardiosurgical intensive care unit, *GICU* general intensive care unit, *MICU* medical intensive care unit, *NICU* neurosurgical intensive care unit

Table 18.4 Determinants of nursing workload in ICU, quantitative studies

Author, year	Factors related to the NW	Factors NOT related to the NW	Sample/ surveys	ICU type
Altafin et al. [19]	↑ Death ($p = 0.001$) ↑ APACHE II (< 0.001), and SOFA ($p < 0.001$) ↓ LOS ($p < 0.001$)	Septic shock ($p = 0.085$)	$n = 437$	GICU
Carmona-Monge et al. [24]	↓ Acute coronary syndrome versus ARDS and septic shock		$n = 536$	GICU
Oliveira et al. [25]	↑ LOS, ($p = 0.036$) ↓ SAPS III ($r = -0.441$), and SOFA ($r = -0.168$)↑ Occurrence of complications ($p < 0.001$)		$n = 287$	CICU
de Souza Nogueira et al. [26]	↑ APACHE II ($p = 0.004$); ↑ Acute lung injury ($p = 0.005$), ↑ Number of the body parts with injury ($p = 0.020$)		$n = 200$	GICU

(continued)

Table 18.4 (continued)

Author, year	Factors related to the NW	Factors NOT related to the NW	Sample/ surveys	ICU type
Lucchini et al. [28]	↑ CPAP >10 cm H_2O and PEEP >10 ($p = 0.01$) ↑ Non invasive ventilation and invasive ventilation ($p < 0.0001$)		$n = 200$	GICU
Lucchini et al. [14]	↑ Patient death versus alive ($p < 0.001$) ↑ECMO ($p < 0.05$) ↑ LOS ($p < 0.003$)	Sedation level SAPS II and III	$n = 5856$	GICU, NICU, CICU
Queijo et al. [35]	↑ Death ($P = 0.038$) ↑ SAPSII ($p = 0.29$, $P = 0.000$)		$n = 100$	NICU

CICU, cardiosurgical intensive care unit; *GICU,* general intensive care unit; *MICU,* medical intensive care unit; *NICU,* neurosurgical intensive care unit

18.4 ESICM (European Society of Intensive Care Medicine) Recommendations on Basic Nursing Requirements for ICU Units [34]

18.4.1 Head Nurse

The nursing staff is managed by a dedicated, full-time head nurse, who is responsible for the functioning and quality of the nursing care. The head nurse should have extensive experience

in intensive care nursing and should be supported by at least one deputy head nurse able to replace him (her). The head nurse should ensure the continuing education of the nursing staff. Head nurses and deputy head nurses should not normally be expected to participate in routine nursing activities. The head nurse works in collaboration with the medical director, and together they provide policies and protocols and directives and support to the team.

18.4.2 Nurses

Intensive care nurses are registered nursing personnel, formally trained in intensive care medicine and emergency medicine. A specific program should be available to assure a minimum of competencies among the nursing staff. An experienced nurse (head nurse or a dedicated nurse) is in charge of education and evaluation of the competencies of the nurses. In the near future, a specific curriculum for ICU nurses should be available. In addition to clinical expertise, some nurses may develop specific skills (e.g., human resource management, equipment, research, teaching new nurses) and assume the responsibility for this aspect of unit management. Staff meetings together with physicians, nurses, and AHCP must be regularly organized in order to carry out the following [34–35]:

- Discuss difficult cases and address ethical issues.
- Present new equipment.
- Discuss protocols.
- Share information and discuss organization of the ICU.
- Provide continuous education.

The number of intensive care nurses necessary to provide appropriate care and observation is calculated according to the levels of care (LOCs) in the ICU.

18.4.3 Levels of Care (LOCs) [38–41]

18.4.3.1 Level of Care III (Highest)

LOC III represents patients with multiple (two or more) acute vital organ failure of an immediate life-threatening character. These patients depend on pharmacological as well as device-related organ support such as hemodynamic support, respiratory assistance, or renal replacement therapy.

18.4.3.2 Level of Care II

LOC II represents patients requiring monitoring and pharmacological and/or device-related support (e.g., hemodynamic support, respiratory assistance, renal replacement therapy) of only one acutely failing vital organ system with a life-threatening character.

18.4.3.3 Level of Care I (Lowest)

LOC I patients experience signs of organ dysfunction necessitating continuous monitoring and minor pharmacological or device-related support. These patients are at risk of developing one or more acute organ failures. This category includes patients recovering from one or more acute vital organ failures but whose condition is too unstable or when the nursing workload is too high/complex to be managed on a regular ward (Tables 18.3–18.5).

For these different LOCs, the following minimum nurse-to-patient ratios are considered to be appropriate (Table 18.6) [34]:

Table 18.5 Nursing workload and clinical pathways

Author, year	Factors related to NW	Sample	ICU type
Altafin et al. [19]	↑ Urgent surgery versus elective surgery and medical type ($p = 0.014$)	$n = 437$	GICU
Debergh et al. [27]	↑ PICU versus MICU ($p = 0.042$)	$n = 225$	PICU, GICU
Lucchini et al. [14]	↑ GICU versus NICU & CICU ($p < 0.001$)	$n = 7588$	GICU, NICU, CICU

CICU cardiosurgical intensive care unit, *GICU* general intensive care unit, *MICU* medical intensive care unit, *NICU* neurosurgical intensive care unit, *PICU* pediatric intensive care unit

Table 18.6 LOC and suggested nurse-to-patient ratio

LOC	Nurse-to-patient ratio	Nursing FTE per ICU bed
III	1/1	6
II	1/2	3
I	1/3	2

LOC level of care, *FTE* full time equivalent

18.5 Conclusions

The endless improvements of hospital strategies in order to provide the highest cost-effective quality of care in the intensive care setting justify the use of evaluating tools for NW supporting the management in the allotment process of limited resources. The aim of this literature's review was to identify the available tools and describe the key factors of NW concept.

The NAS appears to be a precise tool for this task according to several studies [14, 19], although others [16, 23] have underpinned limitations related to misinterpretations of several items that affect feasibility and reliability to describe nursing work inside ICUs.

Data available from the last 6 years have pointed out a lack of knowledge about the intensity of nursing workload. Crucial

factors able to affect NW are related to the severity of illness (e.g., respiratory distress), advanced therapies (e.g., ECMO support-advanced ventilatory strategies), and ICU LOS. Further investigations are needed to reinforce scientific evidence and longitudinal data analysis desirable in order to evaluate potential changes about determinant factors. Nearly 100% of this data review were performed inside ICUs; therefore, enhancing the use of NAS in different aspects of critical care fields appears as mandatory.

The regular daily use of NAS, especially for ICUs with eight or more bed spaces, is able to match the proper LOC, and then it becomes possible to match the variable nurse staffing requirements, modifying the nurse-to-patient ratio based on a proper evaluation of NW.

Take-Home Messages

- NAS has been applied in clinical settings in various types of ICUs.
- The NAS tool is a valuable tool, and its pervasiveness and degree of implementation worldwide indicate its relevance.
- The analysis of the results indicates that NAS was used to test several variables that fall into the structure category (mainly age, sex, and severity of illness), but few variables are related to process.
- With regard to outcome, the most frequently tested variables were mortality and LOS, which are not nurse-sensitive outcomes.

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