Intensive & Critical Care Nursing 45 (2018) 78–84

Contents lists available at ScienceDirect

Intensive & Critical Care Nursing

journal homepage: www.elsevier.com/iccn

Association between patient classification systems and nurse staffing costs in intensive care units: An exploratory study

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ARTICLE INFO

Article history:
Accepted 18 January 2018

Keywords:
Hospital costs
Intensive care units
Nine equivalents of nursing manpower use score
Nursing staff
Nursing activities score
NAS
Workload
NEMS

ABSTRACT

Objectives: Nurse staffing costs represent approximately 60% of total intensive care unit costs. In order to analyse resource allocation in intensive care, we examined the association between nurse staffing costs and two patient classification systems: the nursing activities score (NAS) and nine equivalents of nursing manpower use score (NEMS).
Research methodology/design: A retrospective descriptive correlational analysis of nurse staffing costs and data of 6390 patients extracted from a data warehouse.
Setting: Three intensive care units in a university hospital and one in a regional hospital in Norway.
Main outcome measures: Nurse staffing costs, NAS and NEMS.
Results: For merged data from all units, the NAS was more strongly correlated with monthly nurse staffing costs than was the NEMS. On separate analyses of each ICU, correlations were present for the NAS on basic costs and external overtime costs but were not significant. The annual mean nurse staffing cost for 1% of NAS was 20.9–23.1 euros in the units, which was comparable to 53.3–81.5 euros for 1 NEMS point.
Conclusion: A significant association was found between monthly costs, NAS, and NEMS. Cost of care should be based on individual patients' nursing care needs. The NAS makes nurses' workload visible and may be a helpful classification system in future planning and budgeting of intensive care resources.

Implications for Clinical Practice

- The allocation of resources should be derived according to the needs of individual patients as assessed by the Nusring Activities Score.
- The Nusring Activities Score classification system would be beneficial for managers to match patient needs with nurse staffing requirements and costs.
- The Nusring Activities Score could be used in payment systems of reimbursement.

Introduction

The resourcing of nursing staff is a legitimate concern globally, especially in the benchmarking of intensive care units (ICUs). Benchmarking includes identifying the best practice measurement associated with a given quality or outcome (Finkler and McHugh, 2008). An analysis of human resource operating costs is needed within an ICU to determine if resources are properly allocated according to individual needs (Endacott, 2012; Wunsch et al., 2012). Labour costs are the most important cost driver and in a group of four European countries, the United Kingdom showed the highest labour costs relative to total ICU costs (Tan et al., 2012); this was due to the higher unit costs of ICU specialists and ICU nurses. Cost is connected to numbers of staff and simplified staffing parameters, such as nurse-to-patient ratio, were widely used in earlier times. However, a more precise method than nurse-to-patient ratio is needed to assess and monitor patients' needs and to classify nursing activities and specific interventions (Endacott, 2012; Wunsch et al., 2012; West et al., 2014).

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https://doi.org/10.1016/j.iccn.2018.01.007
0964-3397/

Classification systems measure patient illness severity and classify nursing activities into direct and indirect care. These have been used to quantify clinical performance and to explore the effects of workload on nurse sensitive patient outcomes (Miranda and Jegers, 2012; Kakushi and Martinez Evora, 2014; Lindqvist et al., 2014). Direct patient care comprises of nursing activities, such as hygiene and mobilisation, while indirect patient care involves administrative tasks and coordination. Studies of costs in hospital wards have explored differences in nursing resources using patient classification systems and different costs between diagnosis-related groups (Fagerström and Rauhala, 2007; Andersen et al., 2016). However, this approach has not been common in the benchmarking of ICUs and previous studies of ICU costs had methodological deficiencies (Moerer et al., 2007; Gershengorn et al., 2015; Araújo et al., 2016).

Research has involved workload studies, such as short time-period workload studies, for example, one-day prevalence studies and the use of scripts from existing databases without patient classification systems (Tan et al., 2012; Sakr et al., 2015). The Simplified Therapeutic Intervention Scoring System (TISS-28) was used to evaluate costs in Germany (Moerer et al., 2007) and Finland (Parviainen et al., 2004), whilst the Nine Equivalents of Nursing Manpower Use Score (NEMS) was used to measure nursing costs in Switzerland (Vincent and Moreno, 2010).

It has been hypothesised that the Nursing Activities Score (NAS) can be used as a bottom-up methodological approach to measure costs (Miranda and Jegers, 2012; Araújo et al., 2016) because its content is possibly more specific in assessing nurse activities when compared to the TISS-28 and NEMS. A bottom-up approach starts by assessing cost data for individual patients and measures time spent on nursing interventions, procedures and other tasks (Arthur and James, 1994); conversely, a top-down approach is used only when cost data can be assessed at the unit-level and staffing norms exist, such as the presence of one nurse for each patient on ventilator support (Halpern, 2009; Stafseth et al., 2011; Tan et al., 2012). With electronic systems and classification systems, bottom-up approach means that detailed data are collected at the bedside. To date, only one study from Brazil has used the NAS for cost analysis in ICU using both bottom-up and top-down approaches (Araújo et al., 2016). After implementation in our country, NAS and its relationship with nursing costs has not been examined.

The aim of this study was to analyse whether an association exists between the NAS, NEMS, and ICU nurse staffing costs. The costs of overtime and nurse staffing have been increasing for years (Miranda and Jegers, 2012), whereas the number of patients has remained rather constant (Flaatten and Kvale, 2003; Parviainen et al., 2004; Sakr et al., 2015). We investigated whether patient classification systems might be able to explain or identify ICU costs. Therefore, we hypothesised there is no correlation between NAS and NEMS and ICU nurse staffing costs.

Methods

Design and setting

A retrospective one year follow-up study using a descriptive correlational design of nursing costs was performed in four ICUs in Norway. Two public hospitals were voluntarily recruited, Oslo university hospital and Telemark hospital Skien, a regional non-university hospital. Three units from the university hospital were included, ICU-1, ICU-2, and ICU-3, while the fourth unit, ICU-4, was from the regional hospital (Table 1). The ICU-1 was the largest unit in terms of nursing staff and had the most complex patient case-mix of trauma, sepsis, and neurosurgical patients. The ICU-2 was specialised in neurosurgical patients, had fewer beds and patients than ICU-1. The ICU-3 had the highest number of ICU beds for post-operative surgical patients and trauma patients. The regional hospital (ICU-4) had a broad case-mix, as it was the only ICU in the hospital. All patients admitted during 2012 were retrospectively included in the study and data from ICU patient registers, which recorded all patient admissions, were made available. With regard to ICU-4, patients in day care and children were excluded and so were their nursing costs. This study focused on nurse staffing costs, therefore we excluded costs not directly related to actual patient care, such as those associated with maintenance staff, physicians, nurse managers and educators, accommodation and catering, heating, lighting, overheads, building amortisation and medication costs.

Table 1
Organisational structure of four ICUs in Norway, 2012.

	ICU-1	ICU-2	ICU-3	ICU-4	Total
Organisational Department	University, Division of Emergencies and Critical care	University, Division of Emergencies and Critical care	University, Division of Emergencies and Critical care	Regional, Division of Surgery and Emergencies	University: 3 Regional: 1
Patient case-mix	Trauma, sepsis, and post-operative surgical patients	Neurosurgical patients	Post-operative surgical patients and trauma	All surgical, medical, and paediatric patients	
Technical equipment	Artificial ventilation, RRT	Artificial ventilation	Artificial ventilation	Artificial ventilation, RRT	
Number of RN (FTE)	1	1	14	5	21
Number of CCN (FTE)	82	50	51	64	247
Number of non-nursing staff (FTE)	4	2.7	2	6	14.7
Total*** FTE per 1000 ICU days	29.8	35.5	23.0	26.9	Mean 28.8
Skill-mix: CCN of total number of nurses (%)	98.5	98	78.5	92	Median 91.75
Number of beds	11	7	14	5* + 9 beds for post-surgical care and subunit 6 beds for recovery	37* + 15 beds for post-surgical care
Number of patients on the unit/day Mean (SD)	8.8 (2.3)	5.3 (1.1)	5.4 (1)	4 (3.9)	23.5
Bed occupancy rate (%)	82.7	77.3	61.1	154**	Mean 93.8

RN = registered nurse, CCN = critical care nurses with 1.5–2 years of postgraduate education in critical care nursing, FTE = full-time equivalent, Patient case-mix = range of different categories of patients, RRT = renal replacement therapy.
* ICU beds, ** Bed occupancy rate for 5 ICU beds *** Overtime included.