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SPECIAL ISSUE PAPER

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Acuity, nurse staffing and workforce, missed care and patient outcomes: A cluster-unit-level descriptive comparison

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Abstract

Aim: To compare the patient acuity, nurse staffing and workforce, missed nursing care and patient outcomes among hospital unit-clusters.

Background: Relationships among acuity, nurse staffing and workforce, missed nursing care and patient outcomes are not completely understood.

Method: Descriptive design with data from four unit-clusters: medical, surgical, combined and step-down units. Descriptive statistics were used to compare acuity, nurse staffing coverage, education and expertise, missed nursing care and selected nurse-sensitive outcomes.

Results: Patient acuity in general (medical, surgical and combined) floors is similar to step-down units, with an average of 5.6 required RN hours per patient day. In general wards, available RN hours per patient day reach only 50% of required RN hours to

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meet patient needs. Workforce measures are comparable among unit-clusters, and average missed nursing care is 21%. Patient outcomes vary among unit-clusters.

Conclusion: Patient acuity is similar among unit-clusters, while nurse staffing coverage is halved in general wards. While RN education, expertise and missed care are comparable among unit-clusters, mortality, skin injuries and risk of family compassion fatigue rates are higher in general wards.

Implications for Nursing Management: Nurse managers play a pivotal role in hustling policymakers to address structural understaffing in general wards, to maximize patient safety outcomes.

KEYWORDS

acuity, missed nursing care, patient outcomes, patient safety, staffing

1 | INTRODUCTION

Non-linear relationships among acuity, nurse staffing and workforce, missed nursing care (MNC) and patient outcomes are still not completely understood. The need to identify the levels of nursing staff that should be offered to warrant safe nursing care, contributing to achieve patient outcomes, is a major issue in the nursing agenda (Twigg, Kutzer, Jacob, & Seaman, 2019).

Patient acuity—the categorization of patients as measured by the intensity of registered nurse (RN) care necessary to meet their safety needs, in terms of required RN hours per patient day (*r*NHPPD)—is a critical factor in achieving balanced distribution of workload (Sir, Dundar, Barker Steege, & Pasupathy, 2015), as well as in connecting variables in the network of staffing and patient outcomes, such as length of stay (Pitkäaho, Partanen, Miettinen, & Vehviläinen-Julkunen, 2016).

To properly address patient acuity, staffing planning and assignment require managerial decisions to ensure sufficient resources, either in number of nurses, skill mix, education or in expertise; however, nurse staffing decisions are mostly driven by financial burden, and traditional workload measurement tools tend to simplify the complex work of nurses, with poor sensitivity to inform how to allocate RN resources according to the patient needs (Leary & Punshon, 2019).

Suboptimal care, featured by ward inpatient poor, incomplete or delayed nursing assessment, diagnosis, treatment or referral, which may lead to deleterious patient outcomes, emerged as a significant issue in the nursing literature by the end of the 90s, related to patient complexity and other factors (Quirke, Coombs, & McEldowney, 2011). Similarly, suboptimal staffing was reported in studies demonstrating wide variations in nurse staffing ratios (Aiken et al., 2014), and in those examining the frequency, causes and potential effects of MNC (Ball et al., 2018; Griffiths et al., 2018).

The *failure to carry out necessary nursing care due to inadequate time*, *staffing level or skill mix* (Schubert et al., 2008) was conceptualized as MNC (Kalisch, 2006; Kalisch, Landstrom, & Hinshaw, 2009), and its synonyms and borderline concepts include the following: errors of omission (Kalisch, Landstrom, & Williams, 2009), unmet nursing care needs (Lucero, Lake, & Aiken, 2010), unfinished care (Jones, Hamilton, & Murry, 2015), care rationing (Papastavrou, Andreou, & Vryonides, 2014) and care left undone (Aiken et al., 2001; Ausserhofer et al., 2014; Ball, Murrells, Rafferty, Morrow, & Griffiths, 2013). MNC has been acknowledged as a consequence of workforce shortages, additionally influenced by the perception of nurses on their own responsibilities (Vryonides, Papastavrou, Charalambous, Andreou, & Merkouris, 2015). It has also been related to particular approaches of nurses' judgement in allocating resources (Scott et al., 2019), found to act as a mediator in the relationship between nurse staffing and patient outcomes (Ball et al., 2018), and approached as a structural problem related to social justice (Hopkins Walsh & Dillard-Wright, 2019).

Conversely, a recent study reported two thirds of adult ward inpatients match high-acuity profiles, equivalent to an average of 5.6 *r*NHPPD (Juvé-Udina et al., 2019). Overwhelming demands lead nurses to prioritization of patients and care without complete situational awareness, while adequate staffing based on patient acuity is perceived by frontline nurses as a critical issue for safe patient care (Hegney et al., 2019).

The aim of this study was to compare the patient acuity, RN staffing and workforce measures, missed nursing care and patient outcomes among hospital unit-clusters.

2 | METHODS

2.1 | Design, setting and participants

This is an observational, descriptive, multi-centre design, with patient and workforce data from January to September 2019, conducted in a public hospital system, with three high-tech, metropolitan university

centres, three urban hospitals and two community facilities. The study was granted by the research ethics committee (PR 3581-3/18).

All adult patients admitted in general wards and step-down units (SDU) were considered. Patients from intensive care units, major ambulatory surgery areas, and maternal–child and paediatric units were excluded. Initial population estimation was 100,000 inpatient episodes.

For staffing measurement, RN working in the target units were accounted, excluding nurse managers and clinical nurse specialists acting as consultants.

To assess RN workforce measures and MNC, the sample size was calculated for a maximum uncertainty proportion (p = 50%), a 95% confidence level (α = 0.05) and 0.5 precision (i), resulting in a sample of 386 RN to survey.

2.2 | Data collection and measures

Acuity and patient outcome data were gleaned from the clinical data warehouse containing anonymized data from the patient electronic health records. All patient data collected were blinded using a consecutive participant number. Nurse staffing data were obtained from ward structural assignment reports. MNC survey was conducted within the data collection period of the study (January to September 2019).

2.2.1 | Hospital wards

Traditionally, hospitals have organised their inpatient structures into three main levels of care: acute, intermediate and critical care, although their existence depends on the type of facility, with hospitals having all them and others limited to acute care. This structure coexists with the organisational approach that dichotomized patients according to their admission profile: medical or surgical.

In the setting of this study, all hospitals but one had the three levels of care intensity structures. Acute and intermediate care units were categorized into four main groups: (a) acute care medical units, (b) acute care surgical floors (including major surgery specialties, organ transplantation and short-stay surgical units), (c) acute care combined medical–surgical units (CMSU) and (d) intermediate care (combined medical–surgical step-down units). Acute care units are also referred to as general wards. Intermediate care or step-down units are also named transitional units.

2.2.2 | Patient episode

At unit level, a patient episode consists of all related services for one inpatient from arrival to the ward to transfer to another unit or hospital discharge. Each patient stay in a unit is considered an episode. As during hospitalization patients may be transferred from one unit to another, the sum of cluster-unit-level patient episodes was expected to be higher than the overall number of episodes at hospital level, since at hospital level, an inpatient episode consists of all related services from hospital admission to discharge.

2.2.3 | Patient acuity

The acute to intensive care (ATIC) patient classification system was used to measure acuity (Table 1). Based on the weight of the patient main problem, this tool is structured into ten acuity groups and their equivalence to *r*NHPPD, ranging from occasional to gigaintensive required nursing intensity (Juvé-Udina et al., 2019).

2.2.4 | Staffing measures

Available RN hours per patient day (*a*NHPPD) were aggregated at unit level, according to the unit assignment reports.

The balance between *r*NHPPD and *a*NHPPD was calculated as the difference between both measures, and translated into a percentage of nurse staffing coverage (NSC), that is the proportion of *r*NHPPD to meet patient safety needs reached by the *a*NHPPD.

2.2.5 | Workforce measures

It included RN expertise and RN education. The self-assessment version of the COM-VA tool (Peya & Juvé, 2009), based on Benner's framework of clinical competence (Benner, 1984), was used to rate RN expertise from 0 to 10, being < 6 novice and > 9.5 expert (Appendix S1).

All RN in the context of the study hold a bachelor's degree. RN education was categorized as bachelor's and master's degree.

2.2.6 | Missed nursing care

MNC was measured using the OMICE scale, a transcultural validation for the context of the study (Rey Luque, 2017) of the original MISSCARE survey (Kalisch & Williams, 2009). MNC was rated from 1 (always missed) to 5 (never missed), while reasons for omission were rated from 1 (very important) to 4 (not important).

2.2.7 | Patient outcomes

In-hospital mortality accounted for patients deceased during hospitalization. Unit-acquired nurse-sensitive outcomes (NSO) as e-charted by RN in the care plans or the ongoing assessment sections of the electronic health records considered the number of episodes or events of: central and peripheral line-associated phlebitis, any stage skin injuries (including pressure ulcers, skin tears and frail skin injuries, and moist-associated skin damage (MASD)), injurious and non-injurious falls, delirium (acute confusion and psychomotor

TABLE 1 Acute to intensive care (ATIC) patient classification system

Acuity cluster	Weight range[a]	NP ratio	NHPPD	NMPPD	NHPPS	NMPPS
Gigaintensive	900–1,000	≥2:1	31–42 hr	1,860–2,520	11–14 hr	620–840
	976–1,000		42	2,520	14	840
	951–975		38	2,280	12.6	760
	926–950		34	2,040	11.3	680
	901–925		31	1,860	10.3	620
Megaintensive	801–900	1.5:1	21–30 hr	1,260–1,800	7–10 hr	480–660
	876–900		30	1,800	10	600
	851–875		27	1,620	9	540
	826–850		24	1,440	8	480
	801–825		21	1,260	7	420
Superintensive	701–800	1:1	14–20 hr	840–1,200	4.6–6.6 hr	280–400
	776–800		20	1,200	6.6	400
	751–775		18	1,080	6	360
	726–750		16	960	5.3	320
	701–725		14	840	4.7	280
Intensive	601–700	1:2	10–13 hr	600–780	3.3–4.5 hr	200–260
	676–700		13	780	4.3	260
	651–675		12	720	4	240
	626–650		11	660	3.7	220
	601–625		10	600	3.3	200
Preintensive	501–600	1:3	7–10 hr	450–540	2.5–3 hrr	150–180
	576–600		9.75	585	3.2	195
	551–575		9	540	3	180
	526–550		8.25	495	2.7	165
	501–525		7.5	450	2.5	150
Intermediate	401–500	1:4	5–7h	330–420	1.8–2.3 hr	110–140
	476–500		7	420	2.3	140
	451–475		6.5	390	2.2	130
	426–450		6	360	2	120
	401–425		5.5	330	1.8	110
Intensification	301–400	1:6	3–5 hr	210–300	1.2–1.7 hr	70–100
	376–400		5	300	1.7	100
	351–375		4.5	270	1.5	90
	326–350		4	240	1.3	80
	301–325		3.5	210	1.2	70
Acute	201–300	1:8	2–3 hr	135–180	0.8–1 hr	45–60
	276–300		3	180	1	60
	251–275		2.75	165	0.9	55
	226–250		2.5	150	0.8	50
	201–225		2.25	135	0.8	45

(Continues)

TABLE 1 (Continued)

Acuity cluster	Weight range[a]	NP ratio	NHPPD	NMPPD	NHPPS	NMPPS
Subacute	101–200	1:2	1–2 hr	75–120	0.4–0.7 hr	25–40
	176–200		2	120	0.7	40
	151–175		1.75	105	0.6	35
	126–150		1.5	90	0.5	30
	101–125		1.25	75	0.4	25
Occasional	1–100	1:20	0.1–1 hr	15–60	0.1–0.3h	5–20
	76–100		1	60	0.3	20
	51–75		0.75	45	0.3	15
	26–50		0.5	30	0.2	10
	1–25		0.25	15	0.1	5

Abbreviations: H, hours; NHPPD, nursing hours per patient day; NMPPD, nursing minutes per patient day; NHPPS, nursing hours per patient shift; NMPPS, nursing minutes per patient shift; NP ratio, nurse per patient ratio.

[a] Weight of the patient main problem.

agitation), uncontrolled pain (pain intensity > 3, in a range from 0 to 10), and risk of family/caregiver compassion fatigue (based on the Zarit Caregiver Burden Inventory score and other related assessment items), not present on arrival to the ward.

2.3 | Data analysis

All retrieved data were processed and merged using data mining techniques. Data analyses were performed using SPSS v15 (IBM). Continuous variables were presented as mean and standard deviation, while frequency counts and percentage were calculated for categorical data. Percentage of phlebitis was calculated for episodes of patients with venous lines. The proportion of uncontrolled pain considered episodes of patients with pain as denominator. For selected outcomes, the rate per 1,000 patient days (x1,000pd) was also calculated.

Differences among unit-clusters were analysed using the chi-square test for categorical variables, while for continuous variables, we used Student's *t* test or the Mann–Whitney U test, depending on the results of the Kolmogorov–Smirnov normality test. *p* values less than .05 were considered statistically significant.

3 | RESULTS

The initial population included 94,283 patient episodes. The final analysis excluded 4,559 episodes (4.8%) due to data inconsistencies, duplicates or missed data.

A final sample of 89,724 episodes of adult inpatients in 132 hospital wards (37 medical units, 35 surgical floors, 37 CMSU and 23 SDU) were included in the analysis. Median age was 66.9 (Q1 52.0–Q3 77.8; mean 65.7; *SD* 19.3). The most frequent reasons for admission were cardiocirculatory disorders (*n* = 13,280; 14.8%). Table 2 details the distribution of ward structure, patient characteristics, patient acuity and staffing measures at overall and cluster-unit level.

Similar to those in SDU, most patients admitted to medical wards (77.9% versus 70.8%) matched the intermediate and preintensive acuity profiles, with an average of six *r*NHPPD. Conversely, the lowest mean NSC is observed at the medical unit cluster (44.6%).

Almost two thirds of patients admitted in surgical wards (65.2%) matched the acute and intensification acuity groups (4.6 *r*NHPPD; NSC 55.3%). Nevertheless, when subanalysing separately major surgery floors from short-stay surgical units, almost half the patients admitted to major surgery wards (48.6%) matched the intermediate and preintensive acuity clusters (Appendix S2: Table 2.1).

Table 3 shows the MNC results at each unit-cluster. Overall, 416 RN responded to the questionnaire. Most of them were female (89.7%), and their mean age was 38.9 (*SD* 10.5). Almost half the respondents held a master's degree (47.7%) and rated their clinical expertise as highly competent (mean 8.2). The majority worked as temporary staff (71.1%). 73.4% of RN reported excessive workload and 90.7% reported insufficient staffing in the wards, while 82.4% reported feeling satisfied with their job. Reported average of patient assigned in the last shift was 10.1 in general wards, coincident with the average of 2.4 *a*NHPPD from the assignment reports. In SDU, surveyed RN referred to an average of 6.2 patients assigned in the last shift, distant from the mean 5.8 *a*NHPPD in the reports.

Errors of omission were referred to occur in a range from 6% to 44%. Lower frequencies were reported for: blood glucose monitoring (6%), patient assessment each shift (10%), vital sign assessment (12%), bathing, skin and would care (12%), and handwashing (14%). Average MNC is 21.0%. Appendix S2: Figures 1 and 2 show overall and cluster-unit MNC frequency distribution.

Similarly, the most important reported causes for MNC were related to labour resources regardless of the unit-cluster, ranking urgent patient situations, unexpected rise in patient acuity or volume, and inadequate RN staffing first (Table 4).

TABLE 2 Ward cluster structure, patient characteristics, patient acuity and staffing measures

	All patients	Medical units	Surgical units	Med-Surg units	Step-down units
	n = 89,724 patient episodes	*n* = 26,221 patient episodes	*n* = 41,596 patient episodes	*n* = 36,797 patient episodes	*n* = 6,548 patient episodes
Ward structure					
Units_N	132	37	35	37	23
Beds_N	3,024	929	884	1,053	158
Patient days[a]_N	589,718	190,732	166,657	206,194	2,488
Patient features					
Age > 70_%	46	52.6	39.4	48.5	49.1
Female gender_%	48.5	43.0	45.8	40.2	34.9
Length of stay_mean	5.5	7.4	4.0	6.5	3.7
Hi-tech hospital_%	60.0	68.9	76.5	63.9	81.5
Reason for admission					
Cardiocirculatory_%	14.8	18.4	8.0	18.6	36.3
Infections_%	13.5	24.0	10.7	14.3	3.6
Trauma and orthopaedics_%	12.1	1.4	19.2	16.2	1.8
General surgery_%	11.3	10.4	15.4	7.6	2.2
Digestive_%	10.4	9.2	13.3	8.6	8.0
Nervous system_%	8.3	9.5	3.5	10.3	38.8
Kidney and urinary_%	6.7	3.3	9.5	9.2	3.8
Respiratory_%	6.7	9.8	3.9	7.4	1.8
Reproductive_%	3.7	0.3	5.6	0.4	0.2
Head and neck_%	2.8	0.3	5.7	1.9	0.2
Haematologic and immunologic_%	2.0	8.9	1.4	3.3	2.1
Nutritional and Metabolic_%	1.5	1.6	2.4	0.8	0.9
Skin and burns_%	1.0	0.2	0.4	1.3	0.1
Psychiatric, mental health and addictions_%	0.8	2.4	0.1	0.1	0.1
Eye_%	0.5	0.2	0.7	0.1	0.01
Patient acuity					
Acute (3 rNHPPD)_%	16.0	5.3	33.3	17	5.2
Intensification (4 rNHPPD)_%	26.7	22.1	31.9	29.3	15.7
Intermediate (6 rNHPPD)_%	42.0	50.5	27.4	38.8	60
Preintensive (8 rNHPPD)_%	14.4	20.3	6.9	14.1	17.9
Intensive (12 rNHPPD)_%	0.6	0.7	0.6	0.5	0.7
Superintensive (>13 rNHPPD)_%	0.3	0.3	0.1	0.2	0.5
Staffing measures					
aNHPPD_mean	3.0	2.5	2.4	2.5	5.8
rNHPPD_mean	5.5	6	4.6	5.4	6
Balance	−2.5	−3.5	−2.2	−2.9	−0.2
Nurse staffing coverage_%	57.7	44.6	55.3	46.8	99.2

Abbreviations: Med-Surg Units, combined medical–surgical wards; aNHHPD, available RN hours per patient day; rNHPPD, required RN hours per patient day.

[a]Patient days_ accumulated patient days for the period of the study.

TABLE 3 Reported missed nursing care at cluster-unit level

	All units	Medical units	Surgical units	Med-Surg units	Step-down units
Participants features	***n* = 132**	***n* = 37**	***n* = 35**	***n* = 37**	***n* = 23**
RN participants_N	416	102	54	211	46
Female gender_%	89.7	86.3	92.6	91.0	87
Age_mean (*SD*)	38.9 (10.5)	38.7 (9.9)	39.3 (11.3)	39.4 (10.6)	35.8 (9.6)
Working shift in the same unit_%	95.4	94.1	96.3	95.2	97.8
Master's degree_%	47.7	45.1	35.2[b]	53.1b	45.7
Temporary employment_%	71.1	69.6	70.4	71.6	80.4
Work 35–40 hr per week_%	74.6	78.2	67.3	76.2	67.4
Day (morning or evening shift)_%	62	60.6	63.5	60.8	68.2
Experience_mean years (*SD*)	14.5 (10.2)	14.2 (9.7)	16.0 (11.3)	14.6 (10.5)	12.4 (8.7)
Extra hours_%	15.7	13.9	13.2	16.2	15.2
Sick leave days_mean (*SD*)	1.8 (6.2)	1.4 (4.4)	1.9 (5.2)	1.7 (5.2)	3.2 (12.1)
Intention to leave_%	18.2	14.9	14.8	19.1	24.4
Insufficient staffing in the ward (<75%)_%	91.7	91.1	90.6	93.8	86.4
Excessive workload (>50%)_%	73.4	75.2	79.6	71.3	73.3
Patients assigned in the last shift < 7_%	13.2	8.8	0[a]	7.3[a]	63
Patients assigned in the last shift > 9_%	51.5	52.9	59.3	56.3	19.6
Patient assigned in the last shift_ mean (*SD*)	9.6 (2.9)	10.1 (2.9)	10.1 (2.3)	9.9 (2.5)[b]	6.2 (3.3)
Work satisfaction_mean (*SD*)	2 (0.7)	2.0 (0.7)	1.9 (0.7)	2.0 (0.7)	2.2 (0.9)[a]
Satisfied or very satisfied_%	82.4	83.3	81.5	83.3	75.6
Satisfied or very satisfied working as a nurse_%	90.4	86.3	92.6	94.3[b]	82.2[b]
Satisfied or very satisfied with teamwork_%	71.2	68.6	59.3[b]	74.3	77.8
Clinical expertise_mean (*SD*)	8.2 (0.9)	8.3 (1.1)	8.1 (1.0)	8.3 (0.8)	8.4 (0.6)
Reported missed care_mean (SD)	**All units**	**Medical units**	**Surgical units**	**Med-Surg Units**	**Step-down units**
Ambulation	2.83 (1.11)	2.70 (1.08)	2.81 (1.18)	2.89 (1.10)	2.86 (1.12)
Turning	3.71 (0.96)	3.69 (0.99)	3.67 (0.97)	3.78 (0.96)*	3.51 (0.91)
Feeding	3.95 (0.94)	3.83 (1.15)	3.88 (1.06)	4.00 (0.86)	4.05 (0.61)
Setting up meals	4.22 (0.95)	4.17 (1.02)	4.19 (0.87)	4.24 (0.95)	4.26 (0.90)
Medication administered within 30 min	3.73 (0.96)	3.73 (1.02)	3.69 (1.05)	3.78 (0.93)	3.60 (0.93)
Vital sign assessment	4.47 (0.77)	4.45 (0.81)	4.38 (0.91)	4.49 (0.73)	4.51 (0.70)
Monitoring intake/output	3.89 (0.89)	4.06 (0.87)*	3.79 (0.87)	3.87 (0.92)	3.74 (0.79)
Full documentation	3.83 (0.90)	3.94 (0.95)	3.92 (0.92)	3.90 (0.87)	3.49 (0.83)*
Teaching	3.73 (0.98)	3.65 (1.08)	3.81 (0.84)	3.80 (0.98)	3.53 (0.88)
Emotional support	4.01 (0.91)	4.04 (0.96)	4.02 (0.86)	4.02 (0.94)	3.93 (0.74)
Family or caregiver emotional support	3.76 (0.99)	3.79 (1.06)	3.85 (0.94)	3.75 (0.98)	3.67 (0.89)
Bathing and skin care	4.52 (0.67)	4.45 (0.72)	4.56 (0.62)	4.56 (0.64)	4.40 (0.79)
Mouth care	3.29 (0.98)	3.36 (0.96)	3.48 (1.01)	3.25 (0.96)	3.05 (1.00)
Handwashing	4.46 (0.78)	4.37 (0.95)	4.42 (0.79)	4.54 (0.68)	4.28 (0.77)*
Discharge teaching and planning	3.65 (0.97)	3.65 (1.01)	3.81 (0.94)	3.68 (0.94)	3.37 (1.07)*

(Continues)

TABLE 3 (Continued)

	All units	Medical units	Surgical units	Med-Surg units	Step-down units
Glucose monitoring	4.71 (0.63)	4.74 (0.70)	4.77 (0.66)	4.74 (0.52)	4.44 (0.80)*
Patient assessment each shift	4.58 (0.76)	4.55 (0.86)	4.60 (0.79)	4.61 (0.65)	4.47 (0.96)
Reassessment according to patient status	4.29 (0.87)	4.21 (1.00)	4.44 (0.82)	4.29 (0.80)	4.26 (0.98)
Peripheral venous line assessment and care	3.83 (0.87)	3.88 (1.00)	3.65 (0.93)	3.88 (0.82)	3.74 (0.79)
Central venous line assessment and care	4.10 (0.84)	4.17 (0.94)	4.02 (0.86)	4.11 (0.81)	4.05 (0.78)
Response to call lights within 5 min	4.15 (0.85)	4.20 (0.94)	4.02 (0.86)	4.14 (0.81)	4.21 (0.83)
PRN meds requests acted on within 15 min	4.17 (0.79)	4.11 (0.85)	4.13 (0.73)	4.24 (0.78)*	3.98 (0.74)*
Meds effectiveness assessment	4.08 (0.82)	4.12 (0.88)	4.02 (0.73)	4.10 (0.81)	3.93 (0.86)
Multidisciplinary team meetings	3.54 (1.21)	3.37 (1.28)	3.58 (1.20)	3.69 (1.14)*	3.16 (1.29)*
Toileting needs assistance within 5 min	3.93 (0.84)	3.80 (0.87)	3.93 (0.84)	3.99 (0.86)	3.95 (0.69)
Wound care	4.45 (0.74)	4.36 (0.80)	4.52 (0.77)	4.51 (0.67)	4.30 (0.86)
Sleep and rest care	3.49 (1.05)	3.44 (1.07)	3.54 (1.17)	3.53 (1.02)	3.37 (1.02)
Respiratory care	4.28 (0.84)	4.20 (0.97)	4.29 (0.87)	4.31 (0.79)	4.26 (0.73)
Total	3.99 (0.53)	3.96 (0.58)	3.99 (0.55)	4.02 (0.51)	3.87 (0.46)*

*p value < .001 and < .05.

Finally, Table 5 summarizes all study measures, including patient outcomes in each unit-cluster. Inpatient mortality rate in the medical cluster (3.5%) exceeded twice the value in CMSU (1.5%) and SDU (1.4%), and fourfold the value found in the surgical group (0.7%).

The proportion of episodes with line-associated phlebitis was almost identical in the medical and the SDU clusters (8.9% versus.9.1%), while the rate per 1,000 catheter days was higher in SDU.

Significant differences among unit-cluster were found for unit-acquired skin injuries (p < .05). The proportion of patient episodes with unit-acquired skin injuries was similar in the medical and SDU cluster (2.7% and 2.8%); however, the proportion of unit-acquired skin injuries in general wards (mean 75.6%) was almost threefold the value in SDU (26.6%).

The rates of patient episodes with falls x1,000pd were identical for the medical and SDU clusters (1.8), while the rate of falls x1,000pd was higher in medical wards (2.1), followed by SDU (2.0), CMSU (1.7) and surgical wards (1.2).

Frequency of delirium was higher in SDU (5%; rate 13.1) when compared to the other clusters. Values observed for inpatients in medical and CMSU were similar (4.6 and 4.8), while the rate of delirium at surgical floors (3.6) was significantly lower (p < .05).

Overall, 24% of patient episodes experienced uncontrolled pain. The rate of uncontrolled pain was similar in SDU and surgical floors (64.3 and 63.4, respectively) and lower at CMSU (53.4) and medical wards (41.3).

Risk of caregiver compassion fatigue was more frequently identified in the medical cluster (8.1%; rate 11.2), with similar rates at the surgical and CMSU groups (10.1 and 10.6), while the lowest rate for this outcome was found in SDU (3.5).

Appendix S2: Table 5.1 summarizes all findings comparing general wards with SDU.

4 | DISCUSSION

The main findings of this study indicate that general floors and SDU have comparable patient acuity, as well as similar RN clinical expertise and missed nursing care; however, NSC is halved in general wards when compared to SDU, and patient outcomes differ among unit-clusters, with worse values for medical inpatients.

Regardless of the unit-cluster, a large majority of patients matched intensification and higher acuity categories. These results follow the trend of the ones in a previous study (Juvé-Udina et al., 2019).

At cluster-unit level, patients admitted in SDU and medical wards exhibited the highest acuity profiles, followed by those in CMSU. This finding is comparable with the one found in a longitudinal inquiry, in which acuity score was higher in medical wards, followed by SDU, surgical floors and CMSU (Garcia, 2017). Similarly, several studies identified different acuity levels coexisting in the units (Acar & Butt, 2016; Sir et al., 2015).

Our findings on *a*NHPPD for patients in the general units (mean 2.4) were significantly lower than those found in other studies, where reported mean *a*NHPPD in general wards varied from 4.7 (Griffiths et al., 2019) to 6.0 (Gray & Kerfoot, 2016; Pappas, Davidson, Woodard, Davis, & Welton, 2015; Pitkäaho et al., 2016). Our results are only consistent with the ones described by Chang, Yen, Chang, and Liu (2017), reporting an average of 2.3 *a*NHPPD.

TABLE 4 Reasons for errors of omission

	All units		Medical units		Surgical units		Med-Surg units		Step-down units	
Reason	**Mean**	***SD***	**Mean**	***SD***	**Mean**	***SD***	**Mean**	***SD***	**Mean**	***SD***
Labour resources	**1.74**	**0.56**	**1.72**	**0.53**	**1.83**	**0.68**	**1.75***	**0.57***	**1.67**	**0.45**
Inadequate number of RN staff	1.79	0.88	1.63	0.76	1.76	0.95	1.89	0.89	1.80	1.04
Urgent patient situations	1.53	0.84	1.58	0.83	1.59	0.83	1.51	0.85	1.47	0.84
Unexpected rise in patient acuity in the unit	1.65	0.74	1.57	0.68	1.76	0.82	1.71	0.80	1.51	0.50
Inadequate number of assistive personnel	1.87	0.82	1.79	0.81	1.98	0.98	1.89	0.75	1.87	0.89
Unexpected rise in patient volume (admissions/discharges)	1.66	0.77	1.70	0.73	1.80	0.91	1.66	0.80	1.53	0.59
Excessive administrative tasks load	1.93	0.90	2.04	0.93	2.08	1.02	1.86	0.87	1.82	0.78
Material resources	**2.12**	**0.67**	**2.21**	**0.73**	**2.23**	**0.67**	**2.05**	**0.64**	**2.10**	**0.63**
Medications not available when needed	2.02	0.86	2.06	0.95	2.26	0.83	1.96	0.84	1.98	0.78
Supplies/equipment not available when needed	2.13	0.84	2.23	0.93	2.22	0.81	2.05	0.79	2.18	0.86
Supplies/equipment not functioning properly when needed	2.13	0.89	2.26	0.99	2.22	0.87	2.05	0.85	2.11	0.88
Information systems not functioning properly when needed	2.19	0.92	2.31	0.91	2.24	0.95	2.13	0.92	2.13	0.94
Communication	**2.46**	**0.65**	**2.49**	**0.65**	**2.50**	**0.73**	**2.42**	**0.64**	**2.52**	**0.62**
Unbalanced patient assignments	2.19	0.93	2.35	0.96	2.24	0.95	2.31	0.96	2.11	0.71
Inadequate handoff from previous staff or sending unit	2.52	0.89	2.51	0.93	2.67	0.90	2.46	0.88	2.67	0.85
Other departments did not provide care needed	2.59	0.88	2.59	1.00	2.72	0.83	2.57	0.90	2.51	0.79
Lack of backup support from team members	2.34	1.01	2.38	0.94	2.15	0.96	2.34	1.04	2.51	0.99
Tension or communication breakdowns with the support departments	2.37	0.92	2.46	0.95	2.30	0.96	2.30	0.90	2.51	0.94
Tension or communication breakdowns with the nursing team	2.53	1.05	2.60	1.06	2.59	1.17	2.49	1.02	2.51	1.01
Tension or communication breakdowns with the medical team	2.13	0.96	2.29	1.02	2.33*	1.01*	1.97**	0.89**	2.29	1.01
Nursing assistant did not communicate that care was not done	2.46	1.04	2.35	0.99	2.59	1.17	2.49	1.02	2.47	1.04
Physician off unit or unavailable	2.90	1.09	2.84	1.08	2.89	1.14	2.89	1.11	3.07	1.01

*p value > .001 and < .05;

**p value ≤ .001

TABLE 5 Patient acuity, RN staffing coverage, missed nursing care and patient outcomes

	All units	Medical units *n* = 37	Surgical units *n* = 35	Med-Surg units *n* = 37	Step-down units *n* = 23
Patient episodes_N	89,724	26,221	41,596	36,797	6,548
Patient acuity					
Acute_%	16.0	5.3	33.3	17	5.2
Intensification_%	26.7	22.1	31.9	29.3	15.7
Intermediate_%	42.0	50.5	27.4	38.8	60
Preintensive_%	14.4	20.3	6.9	14.1	17.9
Intensive_%	0.6	0.7	0.6	0.5	0.7
Superintensive_%	0.3	0.3	0.1	0.2	0.5
Staffing and workforce measures					
aNHPPD_mean (*SD*)	3.0 (1.4)	2.5 (0.7)	2.4 (0.5)	2.5 (0.5)	5.8 (0.9)
rHPPD_mean (*SD*)	5.5 (1.3)	6 (0.6)	4.6 (1.0)	5.4 (0.6)	6 (0.6)
Balance	−2.5	−3.5	−2.2	−2.9	−0.2
Nurse staffing coverage_%	57.7	44.6	55.3	46.8	99.2
Reported missed nursing care_%	21.5	20.2	20.8	20.2	22.6
Patient outcomes[c]					
Mortality_N (%)	1,868 (1.7)	907 (3.5)**	300 (0.7)**	568 (1.5)*	93 (1.4)*
Phlebitis_N ep. (%)	7,947 (7.1)	2,324 (8.9)**	2,181 (5.2)**	2,846 (7.7)**	596 (9.1)**
Phlebitis x 1,000 catheter days		13.1	13.4	14.4	19.9
Pressure ulcers_Nep (%)	1,839 (1.6)	610 (2.3)**	419 (1.0)**	631 (1.7)	179 (2.7)**
Pressure ulcers_ Nep (%) intraunit	1,299 (70.6)	461 (75.6)**	292 (69.7)**	498 (78.9)**	48 (26.6)**
Pressure ulcers (intraunit) ep. x 1,000 patient days		2.4	1.8	2.4	1.9
Skin tears_Nep (%)	132 (0.1)	54 (0.2)**	34 (0.1)*	41 (0.1)	3 (0.05)*
Skin tears_Nep x 1,000 patient days		0.3	0.2	0.2	0.1
Moisture-associated skin damage_Nep (%)	243 (0.2)	50 (0.2)	41 (0.1)**	148 (0.4)**	4 (0.1)*
Moisture-associated skin damage_Nep x 1,000 patient days		0.3	0.2	0.7	0.1
Falls_N ep (%)	901 (0.8)	337 (1.3)**	189 (0.5)**	329 (0.9)*	46 (0.7)
Falls ep. x 1,000 patient days		1.8	1.1	1.6	1.8
Falls_N	997	394	204	348	51
Falls x 1,000 patient days		2.1	1.2	1.7	2.0
Delirium_N (%)	2,794 (2.5)	880 (3.4)**	600 (1.4)**	988 (2.7)*	326 (5.0)**
Delirium ep. x 1,000 patient days		4.6	3.6	4.8	13.1
Uncontrolled pain_N (%)	26,692 (24.0)	6,644 (25.3)**	9,269 (22.3)**	9,289 (25.2)**	1,490 (22.8)*
Uncontrolled pain ep. x 1,000 patient painful days		41.3	63.4	53.4	64.3
Caregiver compassion fatigue_N (%)	6,082 (5.5)	2,135 (8.1)**	1,668 (4.0)**	2,191 (6.0)**	88 (1.3)**
Caregiver compassion fatigue ep. x 1,000 patient days		11.2	10.1	10.6	3.5

Note: N ep = number of episodes (patient days at unit level). Overall number of patient episodes is 89,724 since at hospital level, a patient episode accounts for 1. As the patient may be transferred during the hospitalization, it accounts for 1 for each unit cluster they have been reaching a total 111,162. Phlebitis percentage is accounting only for patients with peripheral and/or central venous lines. The proportion of uncontrolled pain considers number of patients with pain as denominator.

*p value > .001 and < .05;

**p value ≤ .001.

Likewise, evidence suggests that RN engaging postgraduate education are more likely to improve critical thinking skills, with reported values of nurses with master's degree ranging from 48% to 57% (Altman, Butler, & Shern, 2016; Barbera Ortega et al., 2015). In this study, the highest proportion of RN holding a master's degree was found in CMSU and the lowest in the surgical unit-cluster, while RN in this latter group were the most experienced. Significant differences were found for years of experience ($p < .05$), with younger nurses working at SDU.

No differences were found for RN expertise among unit clusters. Average RN expertise score was slightly higher than the value reported by O'Leary (2012) using a tool under the same theoretical framework; however, in both cases RN expertise was identified at the high-edge competent level.

Statistically significant differences were found for overall MNC between SDU and general unit-clusters ($p < .01$). A priori less MNC was expected to be observed in SDU as they had better NSC; however, reported MNC was slightly higher in SDU when compared to general wards. This might be related to various factors. First, it has been acknowledged that younger nurses tend to omit more patient care (Blackman et al., 2018). Second, patients are admitted, transferred and discharged according to the selected medical criteria. Nevertheless, these criteria do not necessarily correlate with nurses' judgement on patient needs or required nursing intensity (Gray & Kerfoot, 2016), while nurses tend to accept medical criteria as uncontested (Dalton, Harrison, Malin, & Leavey, 2018) or objectionable according to their expertise. Third, SDU are scarce resource in the hospitals, and patient LOS in these units is minimized. Unit occupancy and activity volume are contributing factors to MNC (Jones et al., 2015). In this context, some interventions, such as ambulation, might not be actually performed in SDU because patients are transferred to general wards before they are able to tolerate their execution.

In all unit-clusters, the most important reported reasons for MNC were related to labour resources, and the most frequent omitted interventions were ambulation and mouth care, both classified as intermediate priority care interventions (Blackman et al., 2018). Sleep care and multidisciplinary team meetings were ranked in the following positions. Teaching and discharge planning interventions were also frequently missed in CMSU and SDU. In this sense, overall MNC results are consistent with findings in previous studies (Ball et al., 2018; Griffiths et al., 2018; Jangland, Teodorsson, Molander, & Muntlin Athlin, 2018).

Conversely, acuity profiles and low NSC in general wards might explain part of the mortality and other NSO, although our analysis is just observational, and no causal relationship can be established.

Mortality, skin injuries and risk of family/caregiver compassion fatigue were more frequent in general wards. Intravenous line-associated phlebitis and delirium were more common in SDU. The proportion of patient episodes experiencing one or more falls is almost identical, while the falls rate was higher in SDU. The percentage of episodes of patients with uncontrolled pain was higher in general wards; however, the rate was lower when compared to SDU.

The association between nurse staffing and mortality has been extensively demonstrated in previous studies (Aiken et al., 2014; Ball et al., 2018; Griffiths et al., 2019), as for the relationship between staffing and falls (He, Staggs, Bergquist-Beringer, & Dunton, 2016). Studies exploring the relationship between staffing and skin injuries exhibit controversial results; however, a longitudinal inquiry found significant association considering both trend and seasonality (He et al., 2016).

No inquiries were located for the association between staffing and caregiver compassion fatigue, an event recently suggested as a significant NSO (Lynch, Shuster, & Lobo, 2018). Evidences on the relationship between nurse staffing and phlebitis or delirium were neither found. Several factors might explain higher rates of delirium and phlebitis in SDU when compared to general units. First, many patients in SDU are in transit between ICU and general wards. Although this study only accounted for unit-acquired outcomes, patient history at ICU and selected drugs used may impact delirium and phlebitis rates. It is known that phlebitis is more likely to occur at any time, with increased catheter days and patient length of stay (LOS) (Ansel, Boyce, & Embree, 2017). Likewise, delirium is more likely to occur in patients with uncontrolled pain (Solà-Miravete et al., 2018), which is consistent with the findings in this study. Finally, most SDU patients in this inquiry matched a surgical profile, which might exemplify the importance of outcome sensitivity measurement when considering selected target populations. NSO sensitivity to target selected patient groups would probably benefit from further refinement work.

4.1 | Limitations

This study was not intended to address causality but to describe acuity, staffing and workforce measures, MNC and patient outcomes in different unit-clusters. Beyond those implicit in such a design, and the fact that no adjustment for hospital type has been applied, additional limitations are acknowledged.

First, patient characteristics were identified as an antecedent to MNC (Jones et al., 2015). Patient acuity and individual complexity are borderline concepts but not synonyms, since individual complexity refers to particular patient features that have the potential to challenge the delivery of nursing care (Adamuz et al., 2018). To what extent individual complexity influences *r*NHPPD and MNC is still uncertain.

Second, we did not consider the nurse work environment that was explicitly represented as an antecedent of MNC (Jones et al., 2015).

Third, SDU are being used as high-intensity and high-churn wards (Hughes, Bobay, Jolly, & Suby, 2015). The use of a churn index might increase the accuracy of required nursing intensity measurement, and explain the part of current MNC, but further research is needed in this sense.

Finally, we neither consider RN unit turnover, which was previously associated with patient outcomes (Kim & Han, 2018),

nor workflows. Nurse workflows are complex, typified by interruptions and rapid task switching, drawing irregular and non-repetitive patterns regardless of patient acuity, assignments and frequency of interventions (Durosaiye, Hadjri, Liyanage, & Bennett, 2018), which might adversely influence RN critical thinking and prioritization and increase the risk of negative workforce outcomes.

4.2 | Implications for nursing management

For more than one decade, nursing resources in European public health care systems have been reduced due to the economic recession, while hospitals were shifting from acute to intensive care settings (Scott et al., 2019). In the context of nursing shortage and financial struggling, social value given to nursing, changes in care models, work environments and organisational approaches are factors influencing intensification of care and care rationing (Blackman et al., 2018). Increased patient acuity and its eventual effects on MNC and patient outcomes might benefit from the use of acuity measurement tools based on patient attributes and nurses' clinical judgement (Firestone-Howard, Zedreck Gonzalez, Dudjak, Ren, & Rader, 2017), such as the patient classification system employed in this study. Likewise, the analysis of patient acuity and outcomes, along with RN staffing and MNC data, may contribute to reinforce the concept of RN, no longer as task performers, but as a knowledge-based workforce (Leary & Punshon, 2019).

Considering that NSC is estimated for safe care, the similarities in acuity distribution between a previous study with 2016–2017 data (Juvé-Udina et al., 2019) and the current one suggest structural RN understaffing in general wards. Recent studies also identify MNC as a structural problem embedded in the work environments (Hopkins Walsh & Dillard-Wright, 2019; Scott et al., 2019). In a context of structural understaffing, nurse managers play a pivotal role in exercising best leadership practices that consider RN expertise and patient acuity, in designing and implementing plans to improve the work environments to minimize MNC, and in hustling policymakers to address structural understaffing in general wards to improve patient outcomes.

5 | CONCLUSION

Patient acuity in general wards is similar to SDU, while NSC is halved. Almost half of RN holding a master's degree and comparable clinical expertise reported MNC slightly varies among unit clusters. RN understaffing in general floors and MNC emerged as structural problems. Mortality, skin injuries and risk of family compassion fatigue rates are higher in general wards, while line-associated phlebitis, delirium and falls are more common in SDU inpatients.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

RESEARCH PROJECT APPROVAL

This research project was approved by the Bellvitge University Hospital Research Ethics Committee (PR 3581-3/18).

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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