Predicting patient acuity according to their main problem

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Abstract

Aim: To assess the ability of the patient main problem to predict acuity in adults admitted to hospital wards and step-down units.

Background: Acuity refers to the categorization of patients based on their required nursing intensity. The relationship between acuity and nurses’ clinical judgment on the patient problems, including their prioritization, is an underexplored issue.

Method: Cross-sectional, multi-centre study in a sample of 200,000 adults. Multivariate analysis of main problems potentially associated with acuity levels higher than acute was performed. Distribution of patients and outcome differences among acuity clusters were evaluated.

Results: The main problems identified are strongly associated with patient acuity. The model exhibits remarkable ability to predict acuity (AUC, 0.814; 95% CI, 0.81–0.816). Most patients (64.8%) match higher than acute categories. Significant differences in terms of mortality, hospital readmission and other outcomes are observed ($p < .005$).

Conclusion: The patient main problem predicts acuity. Most inpatients require more intensive than acute nursing care and their outcomes are adversely affected.

Implications for nursing management: Prospective measurement of acuity, considering nurses’ clinical judgments on the patient main problem, is feasible and may contribute to support nurse management workforce planning and staffing decision-making, and to optimize patients, nurses and organizational outcomes.

KEYWORDS

acuity, clinical judgment, nursing intensity, patient classification systems, priority setting

1 | BACKGROUND

Nursing patient classification systems (PCS) have been employed in relation to nursing staff allocation efforts, budgeting, productivity and workload measurements.

Concepts related to PCS have been used interchangeably over time. Nursing workload refers to time and effort needed to accomplish both direct and indirect patient care, as well as nonpatient care activities (Swiger, Vance, & Patrician, 2016); nursing intensity embeds direct and indirect patient-related nursing care (Liljamo,
Kinnunen, Onhtonen, & Saranto, 2017), whilst patient acuity implies the categorization of patients based on their nursing care needs (Alghamdi, 2016) to determine their required nursing intensity, in terms of nursing hours per patient day (NHPPD).

A widely used PCS is the All Patient Refined Diagnosis-related Groups (APR-DRGs) that cluster hospital discharged patients into groups of medical conditions and procedures, and subclassifies them into four categories of severity and risk of mortality, from low to extreme (Averill et al., 2003); however, its usefulness to determine nursing care requirements or patient acuity remains unclear.

Regardless their design, either prototype—considering only selected relevant nursing tasks—or factor type—including a comprehensive list of nursing procedures—most of nursing PCS are based on interventions scores that may be explanatory of nursing workload, but they are not predictive of acuity or required nursing intensity according to the patient needs (Paulsen, 2018). In addition, front-line and head nurses perceive that workload is more influenced by patient characteristics, status or progress than by activity or tasks. Understanding patient status is essential in bedside decision-making, and it includes data collection, cues capture, critical thinking and clinical judgment, considering the probable course of the patient (Manetti, 2019). In this sense, the relationship between patient acuity and nurses’ clinical judgment is still underexplored.

Despite its conceptual ambiguity, clinical judgment is considered synonymous with decision-making (Nibbelink & Brewer, 2018) and for long, nurses’ clinical judgments on patient problems have been represented by nursing diagnoses (ND) (Juvé-Udina, 2013).

Recently, ND have been studied in relation to hospital length of stay using the NANDA International Classification (D’Agostino et al., 2019) or transfer to ICU and in-hospital mortality employing the ATIC terminology (Juvé-Udina et al., 2017); however, existing PCS do not consider nurses’ clinical judgments on patient problems and their prioritization, although prioritizing impacts nursing workload (Swiger et al., 2016).

In this context, bedside priority setting implies the arrangement of problems to set a preferential order guiding the provision of interventions, to meet the expected outcomes. Thus, prioritization of the patient problems should lead to the identification of a primary diagnosis and other secondary ones. In this sense, the main diagnosis embeds the clinical judgment on the patient problem that generates the greatest need of nursing care in terms of immediacy of its management, care intensity or complexity (Juvé-Udina, 2013).

Nevertheless, whilst the need to develop and implement new predictive models that allow real-time measurements of patient acuity mix is stressed (Welton, 2017), it is still unknown whether patient acuity could be predicted weighting their main problem (MP).

The primary aim of this study is to assess the ability of the patient main problem to predict acuity in adults admitted to hospital wards and step-down units.

The secondary aims are to identify the distribution of acuity according to a PCS based on the MP weights and to evaluate whether differences exist in patient outcomes in terms of mortality, transfer to ICU, hospital readmission and three selected nursing-sensitive adverse events: hospital-acquired pressure injuries, falls and venous access-associated phlebitis.

2 METHODS

2.1 Design, setting and participants

This descriptive, observational, cross-sectional, retrospective, multi-centre study was conducted in 118 adult wards and 15 step-down units, from eight public hospitals: three large, tertiary, metropolitan facilities (500–1,000 beds), three university hospitals (200–500 beds) and two community centres (100–200 beds). Average nurse per patient ratio in these floors is 1:10.5 (6–16) and 1:4 (3–6) in step-down units.

Nurses in these facilities use the ATIC terminology (Appendix 1), employ the same electronic health record (EHR) system and share reason for admission-based standardized care plans (SCP) that each nurse may adjust to the patient needs according to their assessment and judgment.

The study was intended to consecutively include the whole adult inpatient population admitted during 2016 and 2017. This represented a sample estimation of 200,000 patients. Critical care, maternal-child and paediatric patients were excluded.

2.2 Data collection

The institutional research ethics committee approved the study. Data were gleaned blinded according to the current European regulations on data protection. Ethical standards related to data confidentiality (access to records, data encryption and archiving) were complied with throughout the research process (European Commission, 2018).

Patients MP and outcomes data were blindly retrieved from the EHR. APR-DRG severity and risk of mortality data were gleaned from the hospitals minimum data set. A consecutive ID number was assigned to each patient data set.

MP weights were calculated applying the formula \( \sum (\% \text{ severity}) (\% \text{ risk of mortality}) \), considering all adults with the same MP identified in their care plan.

Mean weight variability of each MP was categorized in three groups: low (<5%), moderate (5%-10%) and high (>10%). To estimate the distribution of acuity, a PCS containing ten clusters, 40 sub-groups and their equivalence to NHPPD was used (Appendix 2). The initial capacity of the MP weights to discriminate requirements of nursing intensity was categorized into excellent (>90%), very good (80%-90%), good (70%-80%), sufficient (60%-70%), low (50%-60%) and not useful (<50).

2.3 Data analysis

Descriptive statistics were employed to analyse sample characteristics, continuous variables and categorical data. Pearson's
variation coefficient was used to estimate MP mean weight variability. Univariate analysis was used to assess MP initial discriminatory capacity, expressed in likelihood percentage.

To assess the ability of the MP weights to predict patient acuity, a logistic regression model was used. All potential explanatory variables included in the multivariate analyses were subjected to a correlation matrix for analysis collinearity. Results were reported as odds ratio (OR) at 95% confidence intervals (CI). The goodness of fit of the logistic model was evaluated by the Hosmer-Lemeshow test, and the discriminatory power was assessed by the area under the receiver operating characteristics (ROC) curve.

Significant differences among nursing intensity clusters and patient outcomes were detected using the chi-square test or Fisher’s exact test for categorical variables. For continuous variables, Student’s t test or Mann–Whitney U test was employed, depending on the results of the Kolmogorov-Smirnov normality test. p values less than .05 were considered statistically significant. All reported p values are 2-tailed.

The statistical analyses were performed using version 24.0 of SPSS package (IBM Chicago).

### 3 | RESULTS

The study considered 199,761 patients: 10,467 cases were excluded from the final analysis due to the absence of a care plan, no identification of the MP or not reaching 30 cases (5.2%), whereas 5,617 cases presented missed data or duplicates (2.8%).

The final analyses included 183,677 inpatients: 92.6% admitted in wards and 7.4% in step-down units; 56.1% were male patients, and their mean age was 68.8 years. Average number of problems e-charted in their care plans was 5.1 (range 2–11; 73% risk probability). The proportion of patients with minor or moderate APR-DRG severity and risk of mortality was 76.3% and 82.3%, respectively (Table 1).

#### 3.1 | Discriminatory ability of the main problem to predict acuity

The 183,677 MP considered in the final analysis represent 77 primary diagnostic concepts. Their weights and correspondence to each acuity cluster are detailed in Table 2. Most MP identified exhibit low or moderate mean weight variability (77.1%).

Univariate analysis showed 85.8% of the MP discriminate patients’ requirements of nursing care intensity higher than acute, with excellent (46.7%), very good (23.3%), good (11.6%) and sufficient (5.1%) capacity. Within the acute cluster, five MP initially displayed eventual discriminatory capacity (Table 3).

A first multivariate analysis proved predictive ability of the MP in the intensification and upper clusters and confirmed that, four of those five MP that previously proved capacity exhibit sufficient predictive ability, suggesting they should be considered in the final model. The goodness of fit of this first model was 1, and the area under the ROC curve was 0.812 (95% CI, 0.809–0.815).

Final multivariate analysis findings indicated that there exists a strong association between the MP identified and nursing intensity requirements: their odds ratios are higher than 1, none of the 95% confidence intervals include 1 and most p values are <.001 (Table 4). No indication of collinearity between the variables that remained in the final model was found. The goodness of fit of the model was 1, and the area under the ROC curve was 0.814 (95% CI, 0.811–0.816) (Figure 1).

### Table 1 Baseline sample characteristics

| Characteristic                          | Study population |
|-----------------------------------------|------------------|
|                                         | n = 183,677      |
| Age ≥75 years                           | 58,005           | 31.6  |
| Age (years), median (IQR)               | 67               | 53–78 |
| Male sex                                | 102,764          | 55.9  |
| Medical ward                            | 96,058           | 52.3  |
| Psychiatric ward                        | 608              | 0.3   |
| Step-down unit                          | 13,582           | 7.4   |
| Unscheduled admission                   | 101,749          | 55.4  |
| Length of stay, median (IQR)            | 4                | 2–8   |
| Continuity of care (discharged to another facility) | 7,330            | 4.0   |
| Reason for admission                    |                  |       |
| Cardiocirculatory                       | 30,336           | 16.5  |
| Infectious                              | 27,208           | 14.8  |
| General surgery                         | 20,766           | 11.3  |
| Trauma and orthopaedics                 | 19,951           | 10.8  |
| Digestive, liver and pancreatic         | 19,790           | 10.7  |
| Nervous system                          | 15,472           | 8.4   |
| Kidney and urinary tract                | 13,959           | 7.6   |
| Respiratory                             | 10,971           | 6.0   |
| Reproductive                            | 8,257            | 4.5   |
| Head, neck and maxillofacial            | 5,501            | 3.0   |
| Metabolic, nutritional and endocrinology| 3,064            | 1.7   |
| Haematopoiesis, blood and immunologic   | 2,705            | 1.5   |
| Psychiatric, mental health and addictions| 1,192           | 0.6   |
| Skin and burns                          | 907              | 0.5   |
| Eyes                                    | 857              | 0.5   |
| Other                                   | 2,741            | 1.5   |
| Severity (APR-GRD 3–4)                  | 43,557           | 23.7  |
| Risk of mortality (APR-GRD 3–4)         | 32,558           | 17.7  |
| Severity or risk of mortality (APR-GRD 3–4)| 48,069          | 26.2  |

Abbreviations: IQR, interquartile range; APR-DRG, all patient refined diagnosis-related groups.
### TABLE 2  Main problems weights, variability and correspondence to acuity clusters

| Main problem                                           | N     | Weight | SD    | CI    | PVC (%) | VAR | Acuity cluster |
|---------------------------------------------------------|-------|--------|-------|-------|---------|-----|----------------|
| Post-ICU syndrome                                       | 81    | 716    | 13.65 | 2.95  | 1.89    |     | Low            |
| Risk of multiorgan failure                              | 229   | 661    | 35.46 | 4.5   | 5.63    |     | Moderate Intensive |
| Risk of organ graft rejection                           | 134   | 625    | 20.94 | 3.45  | 3.42    |     | Low Intensive |
| Agony                                                   | 592   | 607    | 8.17  | 0.65  | 1.35    |     | Low Intensive |
| Risk of cardiac tamponade                               | 49    | 567    | 20.68 | 5.79  | 3.65    |     | Low Preintensive |
| Risk of disuse syndrome                                 | 1,044 | 554    | 46.05 | 2.77  | 7.84    |     | Moderate Preintensive |
| Risk of cardiogenic shock                               | 330   | 549    | 4.87  | 0.51  | 0.88    |     | Low Preintensive |
| Risk of neurotoxicity recurrence/progression            | 205   | 540    | 52.89 | 7.1   | 9.05    |     | Moderate Preintensive |
| Risk of ventricular arrhythmia                          | 51    | 538    | 8.17  | 0.65  | 1.35    |     | Low Preintensive |
| Risk of respiratory distress                            | 5,177 | 532    | 22.55 | 0.6   | 4.34    |     | Low Preintensive |
| Risk of hepatorenal syndrome                            | 602   | 524    | 27.7  | 2.18  | 5.17    |     | Moderate Preintensive |
| Risk of encephalopathy recurrence/progression           | 81    | 507    | 13.06 | 1.05  | 2.36    |     | Low Preintensive |
| Risk of acute pulmonary oedema                          | 5,326 | 505    | 24.74 | 0.65  | 4.77    |     | Low Preintensive |
| Risk of septic shock                                    | 1,950 | 500    | 33.75 | 1.47  | 6.44    |     | Moderate Intermediate |
| Risk of thrombocytopenia                                | 190   | 498    | 13.5  | 1.9   | 2.69    |     | Low Intermediate |
| Risk of hypovolaemia                                    | 501   | 486    | 14.1  | 1.22  | 2.96    |     | Low Intermediate |
| Risk of acidosis/alkalosis                              | 1,354 | 484    | 29.3  | 1.54  | 5.84    |     | Moderate Intermediate |
| Risk of acute deterioration                             | 964   | 482    | 1.57  | 0.09  | 0.32    |     | Low Intermediate |
| Risk of autonomic dysreflexia                           | 283   | 474    | 34.75 | 3.93  | 7.3     |     | Moderate Intermediate |
| Risk of thrombocytopenia recurrence/progression          | 933   | 469    | 28.78 | 1.82  | 6.02    |     | Moderate Intermediate |
| Risk of chest tamponade                                 | 600   | 463    | 7.88  | 0.62  | 1.7     |     | Low Intermediate |
| Risk of neurogenic shock                                | 48    | 455    | 36.16 | 9.73  | 7.94    |     | Moderate Intermediate |
| Risk of sepsis                                          | 20,433| 453    | 45.58 | 0.61  | 12.31   |     | High Intermediate |
| Risk of cachectic syndrome recurrence/progression       | 112   | 450    | 8.83  | 1.61  | 1.96    |     | Low Intermediate |
| Risk of uraemic syndrome                                | 123   | 449    | 31.06 | 5.36  | 6.97    |     | Moderate Intermediate |
| Risk of hypovolemic shock                               | 610   | 447    | 19.04 | 1.41  | 4.24    |     | Low Intermediate |
| Risk of delirium recurrence/progression                 | 476   | 439    | 19.14 | 1.68  | 4.37    |     | Low Intermediate |
| Risk of brain vasospasm                                 | 600   | 437    | 15.36 | 1.21  | 3.5     |     | Low Intermediate |
| Risk of hemodynamic instability                         | 589   | 436    | 1.77  | 0.14  | 0.41    |     | Low Intermediate |
| Risk of alkalosis                                       | 215   | 424    | 6.13  | 0.81  | 1.44    |     | Low Intermediate |
| Risk of hypoxaemia recurrence/progression               | 1,426 | 421    | 25.6  | 1.3   | 5.97    |     | Moderate Intermediate |
| Risk of brain ischaemia/haemorrhage recurrence/progress | 6,621 | 418    | 37.18 | 0.88  | 8.11    |     | Moderate Intermediate |
| Risk of hyper/hypovolaemia                              | 897   | 417    | 45.8  | 2.96  | 10.28   |     | High Intermediate |
| Risk of systemic inflammatory response syndrome          | 4,392 | 415    | 32.86 | 0.95  | 7.82    |     | Moderate Intermediate |
| Risk of low cardiac output syndrome                     | 4,734 | 407    | 42.42 | 1.19  | 10.84   |     | High Intermediate |
| Risk of hypovolaemia recurrence/progression             | 2,280 | 404    | 24.32 | 0.98  | 5.9     |     | Moderate Intermediate |
| Uncontrolled chronic pain                               | 472   | 404    | 1.6   | 0.14  | 0.4     |     | Low Intermediate |
| Risk of abdomen compartment syndrome                    | 351   | 394    | 25    | 2.57  | 6.3     |     | Moderate Intensification |
| Risk of suicidal intentionality recurrence/progression  | 39    | 390    | 43.72 | 13.38 | 11.31   |     | High Intensification |
| Risk of liver failure                                   | 1,376 | 389    | 39.79 | 2.07  | 10.35   |     | High Intensification |
| Risk of multiorgan toxicity                             | 542   | 382    | 16.66 | 1.31  | 4.35    |     | Low Intensification |
| Risk of ischaemia recurrence/progression                | 1,101 | 380    | 15.85 | 0.92  | 4.15    |     | Low Intensification |
| Risk of hyperkalaemia                                   | 40    | 380    | 5.05  | 1.57  | 1.33    |     | Low Intensification |

(Continues)
3.2 Distribution of acuity

According to this model, 35.1% of the studied patients are classified in the acute cluster. Most patients fall into the intensification (29.4%) or intermediate (27.7%) categories, which are equivalent to 3.5–5 and 5.5–7 required NHPPD, respectively, whilst around 8% of patients need preintensive, intensive or superintensive care, corresponding to 7.5 to 14 required NHPPD (Table 5). This implies that almost two thirds of the adult inpatient population (64.8%) need more intensive than acute nursing care, equivalent to an average required nursing intensity of 5.6 NHPPD or a 1:4.2 mean nurse per patient ratio. Similar values are found when excluding those patients in step-down units. Considering only ward patients, 63.5% require more intensive than acute care: 7.7% preintensive, 25.5% intermediate, 29.8% intensification and 0.5% intensive or superintensive nursing care, whilst 36.5% are classified in the acute category.

3.3 Patient outcomes

Observed patient outcomes show statistically significant differences among the acuity clusters in terms of adverse events,
**TABLE 3** Initial discriminatory capacity of the main problems

| Main problem                                         | N   | % patients APR-DRG 3–4 | % Likelihood | Predictive capacity | Acuity cluster |
|-------------------------------------------------------|-----|------------------------|--------------|---------------------|----------------|
| Post-ICU syndrome                                     | 81  | 97.53                  | 99.85        | Excellent           | Superintensive |
| Risk of multiorgan failure                           | 229 | 90.39                  | 99.36        | Excellent           | Intensive      |
| Risk of organ graft rejection                        | 134 | 85.07                  | 98.94        | Excellent           | Intensive      |
| Agony                                                 | 592 | 83.95                  | 98.85        | Excellent           | Intensive      |
| Risk of ventricular arrhythmia                        | 51  | 82.35                  | 98.71        | Excellent           | Preintensive   |
| Risk of cardiac tamponade                            | 49  | 79.59                  | 98.46        | Excellent           | Preintensive   |
| Risk of cardiogenic shock                            | 330 | 77.88                  | 98.30        | Excellent           | Preintensive   |
| Risk of disuse syndrome                              | 1,044 | 73.18               | 97.82        | Excellent           | Preintensive   |
| Risk of respiratory distress                         | 5,177 | 72.51               | 97.75        | Excellent           | Preintensive   |
| Risk of cardiorenal syndrome                         | 81  | 70.37                  | 97.50        | Excellent           | Preintensive   |
| Risk of neurotoxicity recurrence/progression         | 205 | 69.76                  | 97.43        | Excellent           | Preintensive   |
| Risk of hepatorenal syndrome                         | 602 | 69.27                  | 97.37        | Excellent           | Preintensive   |
| Risk of encephalopathy recurrence/progression        | 511 | 69.08                  | 97.35        | Excellent           | Preintensive   |
| Risk of acidosis/alkalosis                           | 1,354 | 68.61               | 97.29        | Excellent           | Intermediate   |
| Risk of hypervolaemia                                 | 501 | 67.07                  | 97.10        | Excellent           | Intermediate   |
| Risk of acute pulmonary oedema                       | 5,326 | 61.12               | 96.27        | Excellent           | Preintensive   |
| Risk of autonomic dysreflexia                        | 283 | 60.42                  | 96.17        | Excellent           | Intermediate   |
| Risk of thromboembolism                              | 190 | 60                     | 96.10        | Excellent           | Intermediate   |
| Risk of septic shock                                 | 1,950 | 59.49               | 96.02        | Excellent           | Intermediate   |
| Risk of haemodynamic instability                     | 589 | 56.37                  | 95.50        | Excellent           | Intermediate   |
| Risk of acute deterioration                          | 964 | 55.08                  | 95.28        | Excellent           | Intermediate   |
| Risk of neurogenic shock                             | 48  | 54.17                  | 95.11        | Excellent           | Intermediate   |
| Risk of brain vasospasm                              | 600 | 51.83                  | 94.65        | Excellent           | Intermediate   |
| Risk of chest tamponade                              | 600 | 51.17                  | 94.51        | Excellent           | Intermediate   |
| Risk of thromboembolism recurrence/progression       | 933 | 50.38                  | 94.35        | Excellent           | Intermediate   |
| Risk of sepsis                                       | 20,433 | 49.14               | 94.08        | Excellent           | Intermediate   |
| Risk of hypovolemic shock                            | 610 | 48.03                  | 93.83        | Excellent           | Intermediate   |
| Risk of cachetic syndrome recurrence/progression     | 112 | 47.32                  | 93.66        | Excellent           | Intermediate   |
| Risk of hypoxaemia recurrence/progression            | 1,426 | 46.42               | 93.44        | Excellent           | Intermediate   |
| Risk of alkalosis                                    | 215 | 45.58                  | 93.23        | Excellent           | Intermediate   |
| Risk of uraemic syndrome                             | 123 | 43.9                   | 92.79        | Excellent           | Intermediate   |
| Risk of systemic inflammatory response syndrome       | 4,392 | 40.78               | 91.88        | Excellent           | Intermediate   |
| Risk of delirium recurrence/progression              | 476 | 39.5                   | 91.47        | Excellent           | Intermediate   |
| Risk of hypovolaemia recurrence/progression          | 2,280 | 38.46               | 91.13        | Excellent           | Intermediate   |
| Risk of hyper/hypovolaemia                           | 897 | 35.56                  | 90.08        | Excellent           | Intermediate   |
| Uncontrolled chronic pain                            | 472 | 35.38                  | 90           | Excellent           | Intermediate   |
| Risk of abdomen compartment syndrome                  | 351 | 35.04                  | 89.87        | Very good           | Intensification |
| Risk of effusion recurrence/progression              | 565 | 33.45                  | 89.21        | Very good           | Intensification |
| Risk of brain ischaemia/haemorrhage recurrence/      | 6,621 | 33.26               | 89.12        | Very good           | Intermediate   |
| progression                                          |     |                       |              |                     |                |
| Risk of low cardiac output syndrome                  | 4,734 | 32.81               | 88.93        | Very good           | Intermediate   |
| Risk of ischaemia recurrence/progression             | 1,101 | 32.43               | 88.75        | Very good           | Intensification|
| Risk of liver failure                                | 1,376 | 31.83               | 88.48        | Very good           | Intensification|
| Risk of suicidal intentionality recurrence/progression| 39  | 30.77                  | 87.97        | Very good           | Intensification|

(Continues)
hospital readmission, transfer to ICU and mortality \( (p < .005) \). In comparison with the acute group, outcome values are twofold to fivefold in the intensification category and most values almost twist again for intermediate care acuity group (Table 5). Adverse events display increasing trends in the upper clusters, whilst transfer to ICU decreases, except for those individuals in the superintensive group. When compared to patients classified as requiring acute intensity (0.2%), mortality increases sevenfold within the intensification cluster (1.5%), and up to 3.3% and 5.5% in the intermediate and preintensive categories, respectively (Table 5).

### DISCUSSION

#### 4.1 Discussion of the results

The primary finding of this study is that the MP are independent predictors of patient acuity. The area under the ROC curve (AUC) indicates a remarkable ability of the MP weight model to determine acuity, with an 81% chance to distinguish required nursing intensity among patients admitted in wards and step-down units. Acuity distribution shows most inpatients match acuity clusters higher than

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**TABLE 3 (Continued)**

| Main problem                                      | N     | % patients APR-DRG | % Likelihood | Predictive capacity | Acuity cluster |
|---------------------------------------------------|-------|--------------------|-------------|--------------------|----------------|
| Risk of hypovolaemia                              | 17,605| 26.1               | 85.32       | Very good          | Intensification|
| Risk of increased intracranial pressure           | 3,495 | 25.18              | 84.69       | Very good          | Intensification|
| Risk of airway obstruction                        | 209   | 24.88              | 84.50       | Very good          | Intensification|
| Risk of myocardial ischaemia recurrence/progression| 7,205 | 24.09              | 83.92       | Very good          | Intensification|
| Risk of deliberated self-harm                    | 194   | 23.71              | 83.63       | Very good          | Intensification|
| Risk of hyperkalaemia                            | 40    | 22.5               | 82.67       | Very good          | Intensification|
| Risk of complicated functional recovery           | 51    | 21.57              | 81.88       | Very good          | Intensification|
| Risk of peritonitis                              | 2,010 | 21.44              | 81.79       | Very good          | Intensification|
| Risk of biphasic anaphylaxis                      | 33    | 21.21              | 81.58       | Very good          | Intensification|
| Risk of neurological deterioration                | 2,882 | 20.16              | 80.58       | Very good          | Intensification|
| Risk of neurotoxicity                            | 131   | 19.85              | 80.28       | Very good          | Intensification|
| Risk of nutritional deficit recurrence/progression| 59    | 15.25              | 77.19       | Good               | Acute          |
| Risk of compartment syndrome                     | 338   | 16.86              | 76.96       | Good               | Intensification|
| Risk of ischaemia/haemorrhage                    | 3,114 | 16.28              | 76.19       | Good               | Intensification|
| Risk of hyper/hypoglycaemia                       | 52    | 15.38              | 74.94       | Good               | Intensification|
| Risk of hypoxaemia                               | 3,885 | 15.08              | 74.49       | Good               | Intensification|
| Risk of infection recurrence/progression         | 5,155 | 13.39              | 74.39       | Good               | Acute          |
| Risk of myocardial ischaemia                     | 1,297 | 14.03              | 72.83       | Good               | Intensification|
| Risk of multiorgan toxicity                      | 542   | 13.47              | 71.91       | Good               | Intensification|
| Risk of effusion                                 | 199   | 13.07              | 71.18       | Good               | Intensification|
| Risk of haemorrhage recurrence/progression       | 1,015 | 11.72              | 68.55       | Sufficient         | Intensification|
| Risk of hyperadrenergic syndrome                 | 83    | 9.64               | 66.73       | Sufficient         | Acute          |
| Risk of pancreatitis                             | 814   | 9.21               | 65.61       | Sufficient         | Acute          |
| Risk of delusion recurrence/progression          | 302   | 8.28               | 62.92       | Sufficient         | Acute          |
| Risk of haemorrhage                              | 4,382 | 5.82               | 49.20       | Not useful         | Acute          |
| Risk of anxiety-depression syndrome              | 515   | 5.44               | 47.37       | Not useful         | Acute          |
| Risk of infection                                | 913   | 5.15               | 45.95       | Not useful         | Acute          |
| Activity intolerance                             | 81    | 4.94               | 44.75       | Not useful         | Acute          |
| Risk of postoperative haemorrhage                | 51,803| 4.75               | 43.82       | Not useful         | Acute          |
| Risk of postoperative infection                  | 2,013 | 2.29               | 27.01       | Not useful         | Acute          |
| Risk of hypocalcaemia                            | 1,113 | 1.53               | 19.35       | Not useful         | Acute          |
| Risk of sensory-motor deficit                    | 840   | 13.21              | 19.22       | Not useful         | Acute          |
| Risk of arrhythmia recurrence/progression        | 2,442 | 10.52              | 15.54       | Not useful         | Acute          |
| Risk of decreased intracranial pressure          | 218   | 9.17               | 13.64       | Not useful         | Acute          |

Abbreviations: APR-DRG, all patient refined diagnosis-related groups.
### TABLE 4  
Final multivariate analysis and correspondence with the acuity patient classification system

| Main problem                                                                 | N   | OR   | CI          | p value | Acuity cluster | Weight | NHPPD | Range |
|------------------------------------------------------------------------------|-----|------|-------------|---------|----------------|--------|-------|-------|
| Post-ICU syndrome                                                           | 81  | 649.51 | 159.58-264.66 | <.001   | Superintensive | 716    | 14    | 14-23 |
| Risk of multiorgan failure                                                 | 229 | 154.72 | 99.58-240.39  | <.001   | Intensive      | 661    | 12    | 10-13 |
| Risk of organ graft rejection                                              | 134 | 93.73  | 58.22-150.90  | <.001   | Intensive      | 625    | 10    | 10-13 |
| Agony                                                                       | 592 | 88.03  | 68.92-107.38  | <.001   | Intensive      | 607    | 10    | 10-13 |
| Risk of ventricular arrhythmia                                             | 51  | 76.74  | 37.33-157.75  | <.001   | Preintensive   | 538    | 8.25  | 7.5-10 |
| Risk of cardiac tamponade                                                  | 49  | 64.13  | 31.99-128.55  | <.001   | Preintensive   | 567    | 9     | 7.5-10 |
| Risk of cardiogenic shock                                                  | 330 | 57.89  | 44.55-75.22   | <.001   | Preintensive   | 549    | 8.25  | 7.5-10 |
| Risk of disuse syndrome                                                    | 1,044| 44.87  | 38.98-51.64   | <.001   | Preintensive   | 554    | 9     | 7.5-10 |
| Risk of respiratory distress                                               | 5,177| 43.38  | 31.08-44.20   | <.001   | Preintensive   | 554    | 9     | 7.5-10 |
| Risk of organ graft rejection                                              | 592 | 39.05  | 24.21-62.99   | <.001   | Preintensive   | 507    | 7.5   | 7.5-10 |
| Risk of neurotoxicity recurrence/progression                               | 205 | 37.93  | 28.10-51.18   | <.001   | Preintensive   | 540    | 8.25  | 7.5-10 |
| Risk of hepatorenal syndrome                                               | 602 | 37.06  | 31.08-44.20   | <.001   | Preintensive   | 524    | 7.5   | 7.5-10 |
| Risk of encephalopathy recurrence/progression                              | 511 | 36.74  | 30.37-44.44   | <.001   | Preintensive   | 520    | 7.5   | 7.5-10 |
| Risk of acidosis/alkalosis                                                  | 1,354| 35.94  | 31.91-40.49   | <.001   | Intermediate   | 484    | 7     | 5.5-7 |
| Risk of hypervolaemia                                                       | 501 | 33.49  | 27.72-40.45   | <.001   | Intermediate   | 486    | 7     | 5.5-7 |
| Risk of acute pulmonary oedema                                              | 5,326| 25.84  | 24.25-27.54   | <.001   | Preintensive   | 505    | 7.5   | 7.5-10 |
| Risk of autonomic dysreflexia                                               | 283 | 25.11  | 19.74-31.93   | <.001   | Intermediate   | 474    | 6.5   | 5.5-7 |
| Risk of thrombembolism                                                      | 190 | 24.67  | 18.42-33.03   | <.001   | Intermediate   | 498    | 7     | 5.5-7 |
| Risk of septic shock                                                       | 1,950| 24.15  | 21.94-26.57   | <.001   | Intermediate   | 500    | 7     | 5.5-7 |
| Risk of hemodynamic instability                                             | 589 | 21.24  | 18.00-25.08   | <.001   | Intermediate   | 436    | 6     | 5.5-7 |
| Risk of acute deterioration                                                | 964 | 20.17  | 17.69-22.98   | <.001   | Intermediate   | 482    | 7     | 5.5-7 |
| Risk of neurogenic shock                                                    | 48  | 19.43  | 11.01-34.32   | <.001   | Intermediate   | 455    | 6.5   | 5.5-7 |
| Risk of brain vasospasm                                                    | 600 | 17.7   | 15.03-20.83   | <.001   | Intermediate   | 437    | 6     | 5.5-7 |
| Risk of chest tamponade                                                    | 600 | 17.23  | 14.64-20.28   | <.001   | Intermediate   | 463    | 6.5   | 5.5-7 |
| Risk of thromboembolism recurrence/progression                             | 933 | 16.69  | 14.63-19.05   | <.001   | Intermediate   | 469    | 6.5   | 5.5-7 |
| Risk of sepsis                                                              | 20,433| 15.89  | 15.24-16.57   | <.001   | Intermediate   | 453    | 6.5   | 5.5-7 |
| Risk of hypovolemic shock                                                  | 610 | 15.2   | 12.93-17.87   | <.001   | Intermediate   | 447    | 6     | 5.5-7 |
| Risk of cachectic syndrome recurrence/progression                          | 112 | 14.77  | 10.18-21.43   | <.001   | Intermediate   | 450    | 6     | 5.5-7 |
| Risk of hypoxaemia recurrence/progression                                  | 1,426| 14.25  | 12.78-15.89   | <.001   | Intermediate   | 421    | 5.5   | 5.5-7 |
| Risk of alkalosis                                                           | 215 | 13.77  | 10.51-18.05   | <.001   | Intermediate   | 424    | 5.5   | 5.5-7 |
| Risk of uraemic syndrome                                                    | 123 | 12.87  | 9.00-18.40    | <.001   | Intermediate   | 449    | 6     | 5.5-7 |
| Risk of systemic inflammatory response syndrome                            | 4,392| 11.32  | 10.58-12.12   | <.001   | Intermediate   | 415    | 5.5   | 5.5-7 |
| Risk of delirium recurrence/progression                                     | 476 | 10.73  | 8.91-12.93    | <.001   | Intermediate   | 439    | 6     | 5.5-7 |
| Risk of hypovolaemia recurrence/progression                                 | 2,280| 10.28  | 9.39-11.25    | <.001   | Intermediate   | 404    | 5.5   | 5.5-7 |
| Risk of hyper/hypovolaemia                                                  | 897 | 9.08   | 7.89-10.44    | <.001   | Intermediate   | 417    | 5.5   | 5.5-7 |
| Uncontrolled chronic pain                                                  | 472 | 9      | 7.44-10.90    | <.001   | Intermediate   | 404    | 5.5   | 5.5-7 |
| Risk of abdomen compartment syndrome                                        | 351 | 8.87   | 7.11-11.07    | <.001   | Intensification| 394    | 5     | 3-5   |
| Risk of effusion recurrence/progression                                     | 565 | 8.27   | 6.92-9.87     | <.001   | Intensification| 373    | 4.5   | 3-5   |
| Risk of brain ischaemia/haemorrhage recurrence/progression                 | 6,621| 8.19   | 7.72-8.70     | <.001   | Intermediate   | 418    | 5.5   | 5.5-7 |
In this study, the MP weights seem to be clinically meaningful, refining workload measurements based on “weighted patients according to their care loads” (Wynendaele, Willems, & Trybou, 2019). MP at the top of the ranking dispel this misconception. This is the case for instance of patients diagnosed with agony, the struggle that precedes death in those states in which life is gradually extinguished. Intensive palliative care has been identified for ward groups. In the psychiatric population, factors, such as entrapment, history of self-harm or maladaptive personality traits, may play a role.

Likewise, a recent systematic review identifies the need for refining workload measurements based on “weighted patients according to their care loads” (Wynendaele, Willems, & Trybou, 2019). In this study, the MP weights seem to be clinically meaningful, ranking problems such as post-ICU syndrome or risk of multiorgan failure first. This could suggest that the higher the medical intricacy, the greater the nursing intensity required; however, other MP at the top of the ranking dispel this misconception. This is the case for instance of patients diagnosed with agony, the struggle that precedes death in those states in which life is gradually extinguished. Intensive palliative care has been identified for ward patients at risk for dying soon who experience severe symptoms, reporting an average of 10.3 NHPPD (Fuly, Pires, Souza, Oliveira, & Padilha, 2016).

Regarding mental health MP, none is found within upper acuity groups. In the psychiatric population, factors, such as entrapment, history of self-harm or maladaptive personality traits, may play a role.

### TABLE 4 (Continued)

| Main problem                                           | N  | OR  | CI          | p value | Acuity cluster | Weight | NHPPD | Range |
|--------------------------------------------------------|----|-----|-------------|---------|----------------|--------|-------|-------|
| Risk of low cardiac output syndrome                    | 4,734 | 8.03 | 7.50–8.60 | <.001 | Intermediate | 407 | 5.5 | 5.5–7 |
| Risk of peripheral ischaemia recurrence/progression    | 1,101 | 7.89 | 6.93–8.99 | <.001 | Intensification | 380 | 5 | 3.5–5 |
| Risk of liver failure                                  | 1,376 | 7.68 | 6.83–8.64 | <.001 | Intensification | 389 | 5 | 3.5–5 |
| Risk of suicidal intentionality recurrence/progression | 39  | 7.31 | 3.70–14.44 | <.001 | Intensification | 390 | 5 | 3.5–5 |
| Risk of hypovolaemia                                   | 17,605 | 5.81 | 5.55–6.08 | <.001 | Intensification | 359 | 4.5 | 3.5–5 |
| Risk of increased intracranial pressure                | 3,495 | 5.53 | 5.09–6.01 | <.001 | Intensification | 343 | 4 | 3.5–5 |
| Risk of airway obstruction                             | 209  | 5.45 | 3.97–7.46  | <.001 | Intensification | 330 | 4 | 3.5–5 |
| Risk of myocardial ischaemia recurrence/progression    | 7,205 | 5.22 | 4.90–5.56  | <.001 | Intensification | 371 | 4.5 | 3.5–5 |
| Risk of deliberated self-harm                          | 194  | 5.11 | 3.67–7.13  | <.001 | Intensification | 335 | 4 | 3.5–5 |
| Risk of hyperkalaemia                                  | 40   | 4.77 | 2.27–10.03 | <.001 | Intensification | 380 | 5 | 3.5–5 |
| Risk of complicated functional recovery                | 51   | 4.52 | 2.32–8.82  | <.001 | Intensification | 335 | 4 | 3.5–5 |
| Risk of peritonitis                                     | 2,010 | 4.49 | 4.02–5.02  | <.001 | Intensification | 334 | 4 | 3.5–5 |
| Risk of biphasic anaphylaxis                           | 33   | 4.43 | 1.92–10.21 | <.001 | Intensification | 336 | 4 | 3.5–5 |
| Risk of neurological deterioration                     | 2,882 | 4.15 | 3.77–4.57  | <.001 | Intensification | 331 | 4 | 3.5–5 |
| Risk of neurotoxicity                                   | 131  | 4.07 | 2.65–6.26  | <.001 | Intensification | 324 | 3.5 | 3.5–5 |
| Risk of compartment syndrome                           | 338  | 3.34 | 2.51–4.44  | <.001 | Intensification | 318 | 3.5 | 3.5–5 |
| Risk of ischaemia/haemorrhage                          | 3,114 | 3.2  | 2.89–3.54  | <.001 | Intensification | 324 | 3.5 | 3.5–5 |
| Risk of hyper/hypoglycaemia                            | 52   | 2.99 | 1.41–6.35  | .004  | Intensification | 310 | 3.5 | 3.5–5 |
| Risk of hypoxaemia                                     | 3,885 | 2.92 | 2.66–3.21  | <.001 | Intensification | 315 | 3.5 | 3.5–5 |
| Risk of myocardial ischaemia                           | 1,297 | 2.68 | 2.29–3.15  | <.001 | Intensification | 323 | 3.5 | 3.5–5 |
| Risk of multiorgan toxicity                            | 542  | 2.56 | 2.00–3.28  | <.001 | Intensification | 382 | 5 | 3.5–5 |
| Risk of effusion                                       | 199  | 2.47 | 1.63–3.74  | <.001 | Intensification | 318 | 3.5 | 3.5–5 |
| Risk of haemorrhage recurrence/progression             | 1,015 | 2.18 | 1.80–2.65  | <.001 | Intensification | 301 | 3.5 | 3.5–5 |
| Risk of delusion recurrence/progression                 | 302  | 1.69 | 1.12–2.55  | .012  | Intensification | 301* | 3.5 | 3.5–5 |
| Risk of infection recurrence/progression                | 5,155 | 2.90 | 2.66–3.17  | <.001 | Intensification | 301* | 3.5 | 3.5–5 |
| Risk of nutritional deficit recurrence/progression     | 59   | 3.38 | 1.66–6.88  | .001  | Intensification | 301* | 3.5 | 3.5–5 |
| Risk of pancreatitis                                    | 814  | 1.90 | 1.50–2.42  | <.001 | Intensification | 301* | 3.5 | 3.5–5 |

Note: The goodness of fit of the model was 1 and the area under the ROC curve was 0.814 (95% confidence interval 0.811–0.816). Abbreviations: OR, odds ratio; CI, 95% confidence interval; NHPPD, nursing hours per patient day.

*Final adjusted weight of the four MP initially located at the upper edge of the acute cluster that proved sufficient predictive ability.

Mean weight and intensity cluster adjusted according to univariate and initial multivariate analysis results.
role in acuity assessment. The need for further research in this area has recently been reported (Sousa & Seabra, 2018). Similarly, psycho-emotional and mental health impairments have been described as individual complexity sources (Adamuz et al., 2018), calling for deepening studies on the relationship between acuity and complexity.

According to the findings, 64.8% of the adult inpatient population needs more intensive than acute nursing care, with an average required nursing care intensity of 5.6 NHPPD. This finding aligns with nursing intensity identified in the study on staffing and mortality by Aiken et al. (2017), and are quite consistent with the allocation of an average NHPPD "ranging from 3.5 to 7.5" (Twick & Duffield, 2009). The findings also positively contrast with the results of several studies measuring workload that reported a mean of six to twelve NHPPD in different hospital wards (Silva et al., 2015; Trepichio, Guirardello Ede, Duran, & Brito, 2013). Other inquiries concluded that workload in step-down units was similar to conventional ICUs (Amstrong et al., 2015; D’Orazio, Dragonetti, Finiguerra, & Simone, 2015).

Conversely, information volume has been assessed as a measure of care intensity. The relationship on the number of nursing notes and acuity has been explored (Liljamo, Kinnuen, & Saranto, 2018), and the number of ND has been analysed related to needed nursing intensity (Castellà-Creus, Delgado-Hito, Finiguerra, & Simone, 2015). Other instances; however, a high number of ND might be reflecting poor prioritization and a linear decision-making process, in which each problem seems to be conceived independent from the others and the whole situation of the patient.

Nurses’ priority setting of patient problems is based on urgency, clinical significance, potential harm, impact in daily living and patient perceptions of importance, but prioritization also depends on clinical expertise of registered nurses, time constraints, budget balance, professional values and organizational context (Skirbekk, Hem, & Nortvedt, 2018; Vryonides, Papastavrou, Charalambous, Androu, & Merkouris, 2015). In this sense, positive practice environments enhance nurse expertise to deliver high-quality nursing care and influence their decision-making and priority setting. Nurses’ clinical judgments and patients care plans, essential concepts in this study, are factors considered in the evaluation of practice environments when using the Practice Environment Scale of the Nursing Work Index (Swiger et al., 2017).

In the context of this inquiry, reason for admission, population-based SCP are used to assure patient care quality and safety, and to ease nursing care provision and documentation. Population-based care models are oriented at improving health outcomes of different groups of individuals, and their approach emphasizes prevention and intervention at different echelons, implying the patient exists from the individual and family level, as groups or communities, to populations in themselves (Iseel & Bekemeier, 2010). Likewise, population-based SCP are a form of nursing structural capital, since they are knowledge shifted into information structures that nurses employ to support their clinical decision-making and planning (Covell & Sidani, 2013). The use of SCP could be considered a weakness, since it might influence the prioritization of the MP; however, nurses using them in practice may change any aspect of their content, to adjust SCP to each patient needs based on assessment data analysis (Castellà-Creus, Delgado-Hito, Andrés-Martinez, & Juvé-Udina, 2019). In fact, it is known that nurses’ experience and their understanding of the patient status influence the use of SCP. Experienced nurses tend to favour their own expertise over information contained in a standard to guide their decision-making and properly individualize the SCP to the patient status and needs (Nibbelink & Brewer, 2018).

### 4.2 | Strengths and limitations

To the best of our knowledge, this is the first acuity PCS based on nurses’ clinical judgment on patient problems and their prioritization.

The study presents those limitations implicitly embedded in a retrospective, cross-sectional, limited to a national level inquiry, whilst its multi-centre approach and large sample size are remarkable strengths.

Mean weight variability of the MP was low or moderate in most instances; however, in the absence of similar studies, the categorization of the PVC was just based on the authors’ consensus. High mean heft variability could be related to nurses’ limited knowledge on a selected problem screening or identification (i.e. risk of suicidal intentionality recurrence/progression) or difficulties identifying problems at the borderlines between two or more established entities.
| Features and Outcomes | Acute (n = 64,403 (35.1)) | Intensification (n = 54,059 (29.4)) | Intermediate (n = 50,803 (27.7)) | Preintensive (n = 13,376 (7.3)) | Intensive (n = 363 (0.2)) | Superintensive (n = 81 (0.04)) |
|-----------------------|----------------------------|-----------------------------------|----------------------------------|-------------------------------|--------------------------|---------------------------|
| **Clinical characteristics** |                            |                                   |                                  |                               |                          |                           |
| Age (years), median (IQR) | 62 48–73* | 66 52–77* | 71 58–81* | 76 65–84* | 65 54–77* | 64 56–74 |
| Age ≥75 years          | 13,400 20.8* | 16,357 30.3* | 20,458 40.3* | 8,125 52.2* | 105 28.9 | 16 19.8** |
| Male sex               | 32,147 49.9* | 32,885 60.8* | 29,428 57.9* | 7,752 58* | 215 59.2 | 59 72.8** |
| Severity or mortality risk (APR-GRD 3–4) | 3,256 5.1* | 11,850 21.9* | 22,985 45.2* | 9,081 67.9* | 321 88.4* | 79 97.5* |
| ICU admission           | 1,267 2* | 3,560 6.6* | 4,985 9.8* | 781 5.8 | 221 60.9* | 66 81.5* |
| LOS (days), median (IQR) | 2 1–4* | 5 3–8* | 7 4–11* | 7 5–12* | 15 8–30* | 62 33–90* |
| Continuity of care (another facility) | 1,539 2.4* | 1,720 3.2* | 3,300 6.5* | 726 5.4* | 26 72** | 17 21* |
| **Outcomes** |                            |                                   |                                  |                               |                          |                           |
| Readmission (<31 days) | 654 1* | 2,497 4.6* | 4,286 8.4* | 1,491 11.1* | 32 8.8** | 1 1.2 |
| Transfer to ICU        | 394 0.6* | 842 1.6* | 2,041 4* | 201 1.3* | 8 2.2 | 20 24.7* |
| Adverse event          | 1,932 3* | 4,616 8.5* | 6,526 12.8* | 1,998 14.9* | 61 16.8* | 32 39.5* |
| Phlebitis              | 1,527 2.4* | 3,321 6.1* | 3,913 7.7* | 1,018 7.6* | 32 8.8** | 11 13.6** |
| Pressure ulcer         | 160 0.2* | 378 0.7* | 814 1.6* | 284 2.1* | 12 3.3* | 21 25.9* |
| Falls                  | 173 0.3* | 336 0.6* | 557 1.1* | 144 1.1* | 2 0.6 | 4 4.9** |
| Deceased               | 150 0.2* | 811 1.5* | 1,695 3.3* | 734 5.5* | 21 5.8* | 8 9.9* |

Abbreviations: IQR, interquartile range; APR-GRD, all patient refined diagnosis-related group; ICU, intensive care unit; LOS, length of stay

*Excluded those patients with Agony as the main problem for its relationship with mortality and other outcomes.

*p value <0.001 (categorical variables were compared using the Fisher exact test and continuous variables using the Mann–Whitney test)

**p value >0.001 and <0.05 (categorical variables were compared using the Fisher exact test and continuous variables using the Mann–Whitney test)
(i.e. differentiation between risk of infection recurrence/progression from risk of sepsis), so further studies are needed to gain a better understanding on this issue since, as long as there exist multiple levels of nurses’ clinical expertise, different degrees of situation awareness capacity and clinical judgment accuracy will co-exist (Nibbelink & Brewer, 2018).

In this study, the effect of patient secondary problems and individual complexity factors (Adamuz et al., 2018) were not controlled. To what extent these variables influence acuity at individual level is unknown, so additional studies are granted. In addition, because of its cross-sectional design, changes in patient status could not be considered. Nevertheless, the findings are consistent with the results of a longitudinal inquiry on patient acuity, based on nurses’ clinical judgment that identified a subset of heart failure inpatients classified as requiring higher levels of nursing intensity in terms of NHPPD (Garcia, 2017).

On the other hand, in this investigation, patient outcomes in each acuity group were only analysed for observational purposes, so causal relationships cannot be proven. The findings indicate significant differences on major outcomes among the acuity clusters, suggesting a potential association that has to be demonstrated. Most outcomes p values are statistically significant, but it is acknowledged that p values are dependent on the sample size, so these findings should be interpreted with caution.

Additionally, the terminology used by nurses in this study is not as renowned as other nursing language systems, but it offers conceptual coverage for multiple cascade effect problems and for different types of nurses’ clinical judgments (Juvé-Udina, 2013).

Thompson, Aitken, Doran, and Dowding (2013) classified four types of clinical judgments: those statements describing causality, the actually descriptive, the ones which are evaluative, considering changes in status from one point in time to another, and those predicting the likely course of a patient.

The results of our study suggest that only a few MP identified by nurses are descriptive. Most of them (94%) are risk problems that match predictive or combined type clinical judgments, such as risk of hemodynamic instability (predictive), risk of disuse syndrome (causal and predictive) or risk of peripheral ischaemia recurrence/progression (evaluative and predictive). These types of judgments arise from the combination of several sources of information, with initial and ongoing assessment data being pivotal. In this sense, the results of the present inquiry correspond almost inversely with the ones in a study on prevalent ND in the hospital ward setting using the NANDA-I Classification (D’Agostino et al., 2017), where most of them are actual, descriptive judgments, and only 15% are predictive. To some extent, this might suggest the influence of each language system used to represent nurses’ clinical judgments on patient problems in the EHR.

4.3 Implications for nursing management

A major objective for nurse managers is to strike the balance among nursing care quality, patient safety, practice environment, nursing workload and expenditure. Lack of consideration of patient problem prioritization is one of the factors that may impact quality, safety and workload measurement (Swiger et al., 2016).

Prioritization of nurses’ clinical judgments is essential to identify relationships among problems and avoid severe consequences for patients. All patient needs should be considered, but addressing the MP may contribute to prevent or solve other secondary ones. This implies prioritizing problems contributing, causing or triggering other ones, mostly according to the severity of the patient conditions and their risk of death, both variables considered in the MP weights model presented, found to be predictive of acuity. Moreover, our results coincide to existing evidence on the identification of hospital wards no longer as conventional units, but areas with multiple patient acuity profiles, from acute to superintensive.

The PCS presented does not require the nurse to complete any additional data form to inform patient acuity, since the MP weights can be included as a field in the corresponding database table in any EHR system, for subsequent data mining, exploitation, use or reuse. Moreover, in terms of nursing international data exchange, comparison or benchmarking, given the different nursing and healthcare language systems used in the EHR around the world, concept mappings among terminologies could be employed to minimize the eventual gaps in acuity measurement (Bowles et al., 2013).

Although in this study patient acuity was not confronted to nursing intensity offered, the average nurse per patient ratio in this inquiry (1:10.5) is slightly lighter than the national ratio (1:12.9) and heavier than the European (1:9), according to the data reported in an international cross-sectional survey (Aiken et al., 2012). This might suggest a relevant implication for nursing and healthcare management, ethics and politics, since almost two thirds of adult inpatients might not be receiving the nursing care intensity they need. Nevertheless, further research is needed since average nurse per patient ratio methods may be useful to inform workload at aggregated level but they may result insufficient at unit and individual level (Paulsen, 2018; Welton, 2017).

Finally, the subservient position of nurses has been identified as the “root cause of nurse staffing problems” (van Oostveen, Mathijssen, & Vermeulen, 2015); however, it has been demonstrated that promoting favourable work environments is reasonably low-cost, creating added value for better patient outcomes (Aiken et al., 2018). The use of PCS based on nurses’ clinical judgments may contribute to enhance professional autonomy and to promote less task-oriented and more patient-centred, supportive practice environments. Acknowledging its limitations, the PCS presented exhibits capacity to prospectively inform patient acuity, support workforce planning and staffing decision-making at hospital or unit level, estimate nursing costs and contribute to optimize patients, nurses and organizational outcomes.

5 CONCLUSION

The patient main problem predicts patient acuity, suggesting this PCS is a useful tool to estimate nursing time requirements of adult patients admitted to hospital wards and step-down units.
The majority of adult ward inpatients are in need for more intensive than acute nursing care, and their outcomes in terms of mortality, transfer to ICU, hospital readmission, falls, pressure injuries and catheter-associated phlebitis are observed to be adversely affected, advancing that they are probably not receiving the nursing intensity required.

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AUTHOR CONTRIBUTION

Authors contributed equally to this work.

ETHICAL APPROVAL

An ethics application for the research project was submitted to the Bellvitge University Hospital Research Ethics Committee granting approval (PR 3851/18).

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