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Multicentre cross-sectional study to assess nursing workload in Belgian emergency departments

Thomas Ganty,[1] Julien Szecel,[2] Anh Diep,[3] Alexandre Ghuysen,[2,3] Méryl Paquay [2,3]

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[1]Hôpitaux Iris Sud HIS, Brussel, Brussel, Belgium
[2]Emergency Department, CHU de Liège, Liege, Belgium
[3]Public Health, Université de Liège, Liege, Belgium

Correspondence to
Professor Méryl Paquay;
meryl.paquay@chuliege.be

AG and MP contributed equally.

AG and MP are joint senior authors.

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ABSTRACT

Background Excessive workload in emergency departments (ED) negatively affects patient safety, often leading to missed critical tasks due to time constraints. The Workload Assessment of Nurses on Emergency (WANE) scale developed in Belgium offers a detailed measurement of nursing workload, but its complexity makes it hard to use in practice. Our study aims to find a simpler method for assessing nursing workload in EDs.

Methods A multicentre cross-sectional study was performed in four Belgian EDs between September 2022 and March 2023. Nursing workload was assessed using the WANE scale in each hospital, during 4-hour time periods. The associations between WANE scores, and nurses' subjective workload assessment, number of patients, patient triage levels, post-triage destination area and the Jones Dependency Tool Score were examined employing multiple linear regression models.

Results 161 nurses, caring for 591 patients, were included. 67% of the variation in 'direct' care time could be explained with a model based on triage level and two items of the Jones Dependency Tool (ABC perturbation and mobility). The number of new patients admitted and nurses' perceived workload were also highly associated with the total nursing care time TNCT. The actual number of patients in the ED at any time explained 78% of the variation in TNCT. Each additional patient increases the TNTC by 45.22 min.

Conclusions Simple indicators might be used to evaluate the nursing care time in Belgian EDs. A retrospective method is suggested, using the total number of patients over a defined period of time. This study reveals a path to a predictive method to calculate the direct care time for each patient with three simple indicators, available from nursing triage stage.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Several care units have established precise patient-to-nurse ratios. In contrast, these are rare for emergency departments (EDs).

WHAT THIS STUDY ADDS

⇒ This multicentre cross-sectional study in Belgian EDs demonstrates that each additional patient increases nursing care time by 45 min, explaining 78% of workload variation—rising to 83% in EDs without pre-established areas of care according to the severity of health issues, apart from the resuscitation area.

⇒ We also demonstrate how three basic indicators (triage level and two items on the Jones Dependency scale, obtained during triage) can accurately estimate direct care time for all patients.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study provides evidence to incorporate total patient numbers and triage data into workload assessment tools, improving accuracy and adaptability for real-time staffing adjustments in EDs.

BACKGROUND

In Belgium, 125 emergency departments (EDs) serve a large and diverse population, with an average of 55 daily patient contacts per department.[1 2] Between 2010 and 2019, EDs experienced a 23% increase in daily contacts, reflecting a broader trend in hospital admissions. Concurrently, there has been a notable increase in nursing workload intensity in hospitals, which includes both direct (patient care) and indirect care tasks (management and mentoring) largely due to shorter hospital length of stay (increased turnover) and increasing patient complexity.[3 4]

Despite the critical role of nursing, there are no established patient-to-nurse ratios in Belgium EDs, unlike those in other specialised care units.[5–7] Research has consistently shown that patient-to-nurse ratios significantly affect patient outcomes, including mortality rates.[3 8] Additionally, high workloads are known to impact the quality of care, affecting factors such as patient experience, pain management and overall ED efficiency.[9–15] These findings underscore the need for effective workload assessment tools in ED settings.

Internationally, various tools have been developed to measure ED workload, such as the Jones Dependency Tool (JDT) and the UK's Baseline Emergency Staffing Tool.[16 17] In Belgium, the Workload Assessment of Nurses in Emergency (WANE) scale was introduced in 2019 to offer a measurement of nursing workload.[18] While the WANE scale is comprehensive, its complexity can limit practical application. Indeed, the scale's accuracy relies on detailed documentation of all tasks performed during the shift. While nursing records capture many tasks, they are not able to capture all the tasks that are completed in emergency care. Additionally, indirect care tasks, which make up a large part of nursing workload, cannot be measured with current tools in EDs.

Mismatch between staffing levels and workload in EDs can have serious effects, highlighting the need for effective yet simple assessment tools. Using readily available indicators. Our study aims to find

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an easier and more practical method for assessing the workload of ED nurses.

METHODS

Design

A prospective cross-sectional multicentre study was performed from September 2022 to March 2023, within four general hospitals in the Walloon-Brussels Federation, including three secondary hospitals and one tertiary hospital. Our primary hypothesis was that simple indicators could be used to assess nursing workload in EDs. Our secondary hypotheses were that nursing workload could be assessed using the subjective perception of workload by nurses and the number of contacts in the ED and three patient characteristics such as dependency and severity of illness.

Setting

Belgium has 103 hospitals, including seven university hospitals directly affiliated with universities and 16 general hospitals with university status, which collaborate with academic institutions for teaching and research. Of these, 30% are public, managed by public authorities such as municipalities, intermunicipal associations, provinces or regions, while 70% are private and organised as non-profit organisations. The country also has 125 emergency departments, comprising 121 specialised emergency care units and four primary emergency care units.

Participating hospitals

EDs eligible for inclusion in the study needed to be legally accredited emergency services, located within the Brussels-Capital Region or the Walloon Region, and where the primary language spoken within the service is French. We excluded services primarily or exclusively catering to patients aged under 16.

To ensure diversity among the selected services, we planned to include four hospitals. This number was chosen to balance the study's resources while allowing for a meaningful representation of the different characteristics of emergency departments in Belgium, in line with the criteria mentioned below.

- At least one of the included services must have a prehospital function.
- Number of contacts criteria (based on 2019 figures—the last 'normal' year 9 before the COVID-19 pandemic)
  - At least one service must handle fewer than 25 000 patients annually.
  - At least one service must handle between 25 000 and 50,000 patients.
  - At least one service must handle at least 60,000 patients annually.
- Academic criterion:
  - At least one service must have a 'university' character and be officially recognised as such in the Public Health SPF database (official certification).
- Organisational Criteria:
  - At least one service must have pre-established area (specific organisation where each nurse/physician team is assigned to a specific care area for the day), apart from the resuscitation area
  - At least one service must not have pre-established areas of care (specific organisation where each nurse/physician team is assigned to a specific care area for the day), apart from the resuscitation area.
- Geographic criteria:
  - At least one service must be located in the Walloon Region
  - At least one service must be located in the Brussels-Capital Region.

Data collection

The WANE tool was selected as the reference standard for nursing workload, due to its validation in French and its alignment with the Belgian cultural and healthcare context.[18] Throughout the study, a total of 32 sets of 4-hour observations were systematically conducted at different times of the day, resulting in eight series per hospital:

- Two series in the morning (8:00–12:00).
- Two series in the afternoon (14:00–18:00).
- series in the evening (20:00–24:00).
- Two series at night (1:00–5:00).

To introduce variability in observation conditions, multiple periods (morning, afternoon, evening, night) were intentionally selected on different weekdays.

Data collection was conducted during the autumn and winter periods, with series distributed evenly across hospitals and time slots. The goal was not to compare workload variations between these periods but to minimise the influence of external factors. This allowed us to collect representative data over different time periods (figure 1).

We included all professionals involved in patient nursing care during the observation periods, including specialist nurses, general nurses and healthcare assistants. The term 'nurse' will be used interchangeably in this article to refer to all these professionals providing nursing care as part of a team. We also considered the interventions and care they provided as well as the profiles of the patients they attended to.

Study procedures

Selected EDs were contacted in advance to present the study protocol and researcher's requirements. On EDs managers' approval, observation dates were systematically scheduled. A written guide (vade-mecum) was provided to the unit managers. The study periods were strategically planned using a 'judgemental' methodology, considering the researcher's schedule and service availability. During observation periods, the study's objectives and methodology were individually communicated to each participating nurse, allowing clarifications and, if necessary, decline participation. If one or more nurses working during that observation period declined, the series was promptly cancelled and rescheduled. When unanimous agreement was achieved, the researcher initiated a 4-hour timing using a stopwatch.

Data were collected from all areas of the included EDs. Throughout the data collection process, the principal researcher was consistently present to ensure the quality and methodological reproducibility of data collection (time and respect of the defined methodology) and to observe adherence to the study. The researcher's ongoing presence enabled direct communication with the teams for any questions or feedback. Importantly, the researcher did not interfere with the assessments conducted by the nurses, such as triage or subjective workload evaluations.

At the beginning of the 4 hour period, nurses were given a 'Direct Care' sheet (derived from the WANE scale) for each patient they were caring for, whether already present in the ED or newly registered. A checkmark was to be placed next to each care task performed by the nurse. Interventions repeated multiple times required subsequent additional checkmarks for each occurrence. This sheet was also used by the triage nurse to

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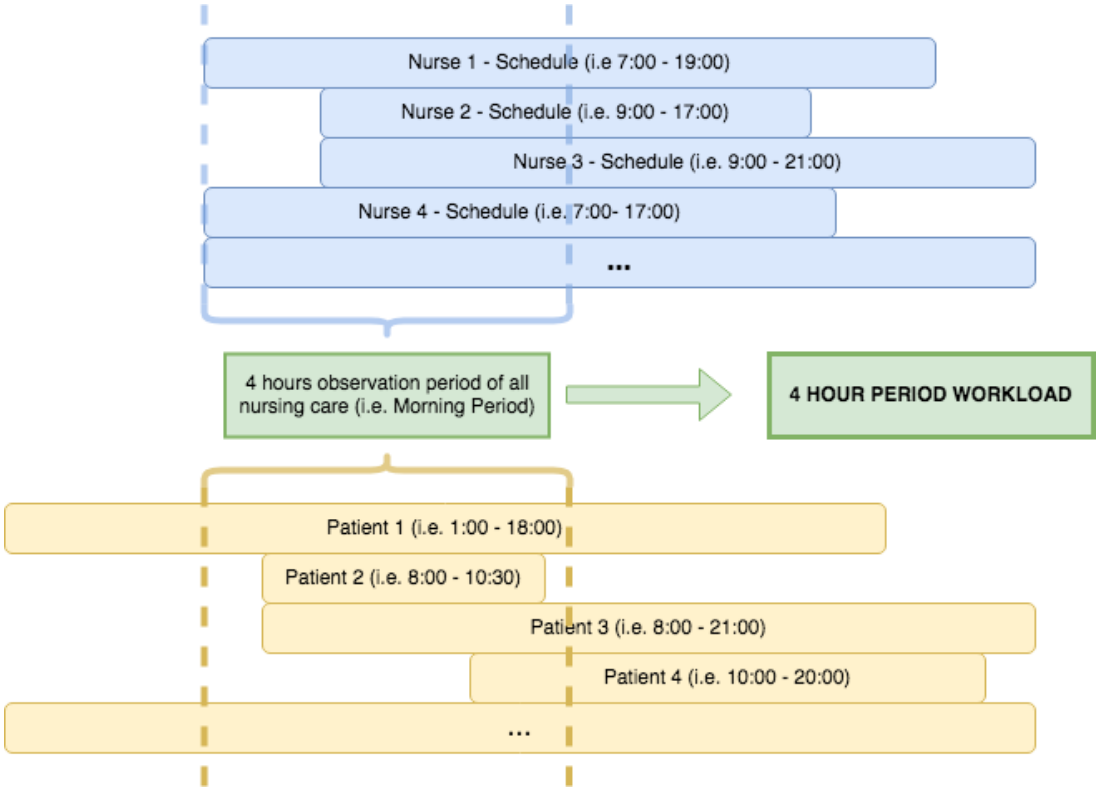

Figure 1 Illustration of a 4-hour observation period.

complete The Jones Dependency Scale, which is a multidimensional measure of patient dependency and to enter the initial triage level, which was considered a marker of severity.

At the end of the 4-hour period, the researcher collected all 'Direct Care' sheets. The 'Indirect Care' sheets (derived from the WANE scale) were distributed to each nurse to estimate the total time spent on administrative, logistical, organisational and other non-patient contact tasks. Additionally, on the same sheet, they were asked to evaluate the perceived workload for the past 4 hours on a scale ranging from 0 (no perceived workload) to 10 (very high perceived workload) (figure 2).

Study variables and statistical analyses

The dependent variable for the prediction analyses was the total workload measured in minutes within a 4-hour period using the WANE scale.[18] This included the sum of direct care and indirect care. We then analysed the association of this dependent variable with other variables collected during the 4-hour periods, employing univariate and multivariable linear regression models. This included the total number of patients (patients already present at the beginning of the 4-hour period+new patients), as well as patient, nursing and ED variables:

- Patient variables: sex, age, JDT scores and each of its five dimensions, triage level (severity), post-triage destination area (reanimation area, lying area, chair area, ambulatory area) and patient presence at the beginning/end of the 4-hour observation period.
- Nursing variables: subjective workload assessment (0–10) after the 4-hour observation period.

Data analyses

Descriptive statistics were provided for patient characteristics, numbers of patients and nursing subjective workload. Based on observations, the total number of minutes of direct, indirect and total workload was calculated using the WANE score. We then performed analyses to determine the association of routine variables collected with the direct, indirect and total care time calculated by the WANE score.

Univariate and multivariable linear regression was performed to determine the association of patient variables with the direct care time calculated by the WANE score as it was the only time metric allowing for individual analyses.

Variables with a significant p value ($p<0.05$) in the univariate regression were used to determine the variables entered into the multivariable model. The model was subjected to the condition of a Generalised Variance Inflation Factors (GVIF), which is used to predict the intensity of a possible multicollinearity <5 to avoid collinearity between collected variables. Results were presented with the estimates and their respective 95% CI, p value and the R^2.

Only complete cases (ie, where the patient's entire stay in the ED occurred during the observation period) were retained to ensure that the direct care times used were fully representative of each patient. However, incomplete cases were still included to calculate total care time.

The association of the nurses' subjective workload with the indirect time calculated by WANE was examined using a non-parametric Spearman test. Additionally, a Spearman test was employed to explore the potential relationship between the total time spent on indirect care and the total time spent on direct care.

For the total time spent on nursing care (direct care and indirect care), univariate linear regression was performed including the number of new patients, total number of patients and subjective workload evaluation (0–10). Additional analyses were iteratively performed based on hospital groupings defined by their

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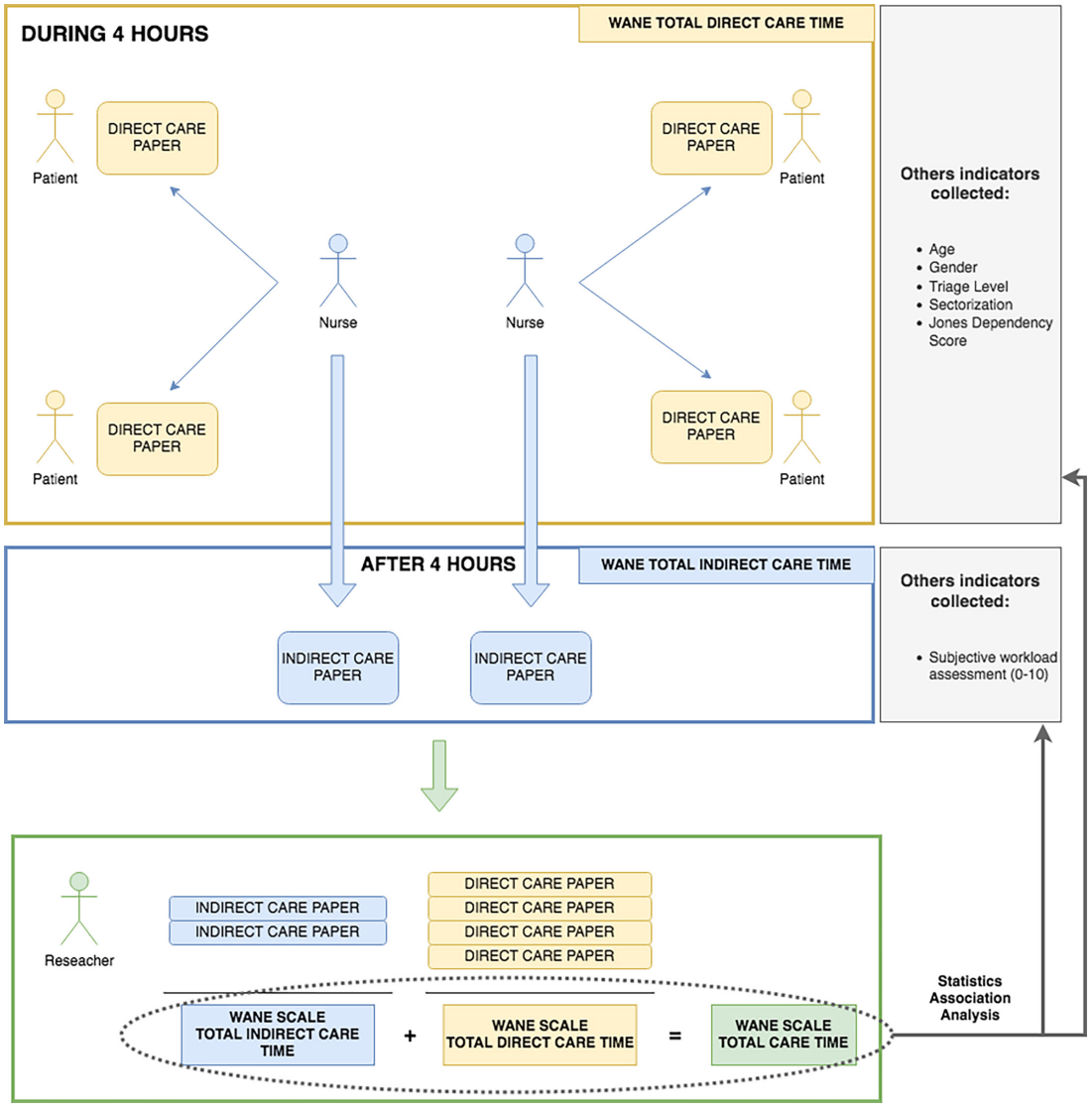

Figure 2 Overview of data collection and analysis methodology.

characteristics, including secondary/tertiary and pre-established/non pre-established area of care distinctions.

Ethical considerations

The study protocol obtained approval from the Ethics Committee of the University Hospital of Liège on 26 July 2022, under reference 2022/194. As outlined in the data collection section, prior consent was sought from the hospitals. Additionally, individual oral consent was systematically obtained from the nurses participating in the study.

Patient and public involvement

Although patients and the public were not directly involved in the design, conduct, reporting or dissemination plans, they were represented through our ethics committee (which includes healthcare professionals, academics as well as members of the public and patients) that revised our protocol.

RESULTS

Four hospitals were selected based on the criteria outlined in the methodology. Over the observation periods, 591 patients cared for by 161 nurses were included. No patient or nurse data had to be excluded from the study. For analyses related to patients and involving direct care time, patients who did not receive complete care were excluded from non-descriptive statistical analyses (231 complete care episodes from a total of 591). In the series, the median number of new registrations was 9.5 (range: 4–16.25) with a median total of patients managed at 16 (range: 7.75–22.5). The median subjective workload assessment per observation period (on a scale between 0 and 10) was 3.9 (range: 2.38–4.89).

Patient analyses (direct care time)

Tables 1 and 2 provide descriptive analyses of patient characteristics collected during the study. Patients are divided into three groups: all patients, new cases (patients who arrived during the observation period) and complete cases (patients who both arrived and were discharged within the observation period). For patients who received complete care, the median time dedicated to direct care calculated by WANE was 10.6 min (range: 6–23.3) (table 2).

In univariate analyses, all variables, except sex, exhibited a statistically significant association with direct care time and were entered into a multivariable model for assessing variables

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Table 1 Patients descriptive statistics—qualitative and categorical variables

Variable	Mode	n (%)—All	n (%)—New	n (%)—Complete
Sex	Female	308 (52.12)	198 (51.16)	119 (51.52)
	Male	283 (47.88)	189 (48.84)	112 (48.48)
Age (years)	0–12	24 (4.06)	21 (5.43)	16 (6.93)
	13–17	17 (2,88)	16 (4.13)	13 (5.63)
	18–64	385 (65.14)	265 (68.48)	160 (69.26)
	65+	165 (27.92)	85 (21.96)	42 (18.18)
Triage level	Immediate (Lvl 1)	10 (1.76)	6 (1.64)	3 (1.30)
	Very urgent (Lvl 2)	81 (14.26)	31 (8.49)	7 (3.03)
	Urgent (Lvl3)	204 (35.92)	96 (26.30)	39 (16.88)
	Standard (Lvl 4)	209 (36.80)	183 (50.14)	145 (62.77)
	Non-urgent (Lvl 5)	64 (11.27)	49 (13.42)	37 (16.02)
Post-triage destination area	Reanimation area	12 (2.11)	8 (2.19)	2 (0.87)
	Lying area	247 (43.49)	105 (28.77)	35 (15.15)
	Chair area	61 (10.74)	37 (10.14)	15 (6.49)
	Ambulatory area	248 (43.66)	215 (58.90)	179 (77.49)

All cases (n = 591); new cases (n = 387); complete cases (n = 231).

independently associated with direct care time (table 3). Due to collinearity, the model had to be adjusted to determine a model with a GVIF<5. The adapted multivariable model, incorporating triage level and two JDT items (ABC stability and mobility), accounts for 67% of the variability in time dedicated to direct care (95% CI 60% to 74% and GVIFx(i) < 5).

Table 2 Patients descriptive statistics

Variable	Median (IQR) (all cases)	Median (IQR) (new cases)	Median (IQR) (complete cases)
Direct care time (min)	13.6 (6–34.6)	14.6 (6.7–34.9)	10.6 (6–23.3)
Age (years)	44 (29–67)	41 (27–62)	37 (24.5–57)
Jones Dependency Tool Score	7 (6 – 8)	6 (6 – 7)	6 (6 – 7)
Variable	n (%) (all cases)	n (%) (new cases)	n (%) (complete cases)
Triage level			
Level 1	10 (1.76)	6 (1.64)	3 (1.30)
Level 2	81 (14.26)	31 (8.49)	7 (3.03)
Level 3	204 (35.92)	96 (26.30)	39 (16.88)
Level 4	209 (36.80)	183 (50.14)	145 (62.77)
Level 5	64 (11.27)	49 (13.42)	37 (16.02)
Jones Dependency Tool			
Mobility			
Zero to mild (1)	400 (82.82)	302 (84.59)	210 (92.11)
Moderate (2)	51 (10.56)	37 (10.36)	14 (6.14)
High to total (3)	32 (6.63)	18 (5.04)	4 (1.75)
Stability			
Zero to mild (1)	443 (91.72)	333 (93.28)	222 (97.37)
Moderate (2)	35 (7.25)	20 (5.60)	3 (1.32)
High to total (3)	5 (1.04)	4 (1.12)	3 (1.32)
Communication			
Zero to mild (1)	378 (78.26)	293 (82.07)	203 (89.04)
Moderate (2)	69 (14.29)	42 (11.76)	16 (7.02)
High to total (3)	36 (7.45)	22 (6.16)	9 (3.95)
Needs			
Zero to mild (1)	433 (89.65)	329 (92.16)	220 (96.49)
Moderate (2)	35 (7.25)	19 (5.32)	6 (2.63)
High to total (3)	15 (3.11)	9 (2.52)	2 (0.88)
Security		315 (88.24)	211 (92.54)
Zero to mild (1)	413 (85.51)	30 (8.40)	12 (5.26)
Moderate (2)	54 (11.18)	12 (3.36)	5 (2.19)
High to total (3)	16 (3.31)		

All cases (n=591); new cases (n=387); complete cases (n=231).

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Table 3 Multiple regression model of direct care time per patient with full management in the observation period (n=231)

Variable	β (95% CI)	R^2	β (95% CI)	R^2	β (95% CI)	c
Intercept	–	–	38.71 (32.47 to 44.96)	0.76	32.49 (27.70 to 37.29)	0.67
Age (years)	0.23 (0.08 to 0.37)	0.04	0.03 (–0.06 to 0.11)	–	–	–
Sex (male)	–3.74 (–10.19 to 2.71)	NS	–	–	–	–
Triage level						
Level 3	Ref	0.49	Ref		Ref	
Level 1	97.23 (76.32 to 118.13)		–12.77 (–39.53 to 13.99)		19.17 (–4.45 to 42.79)	
Level 2	30.19 (15.87 to 44.51)		41.55 (14.92 to 68.17)		8.88 (–5.40 to 23.17)	
Level 4	–21.97 (–28.26 to -15.67)		–9.02 (–20.19 to 2.15)		–18.87 (–24.17 to –13.56)	
Level 5	–25.29 (–33.30 to -17.29)		–13.04 (–24.80 to -1.27		–21.96 (–28.65 to –15.27)	
Post-triage destination area						
Lying area	Ref	0.64	Ref		–	–
Resuscitation area	149.54 (–37.45 to –26.59)		170.18 (117.57 to 222.78)			
Chair area	–19.48 (–28.55 to –10.41)		–9.82 (–18.57 to –1.07)			
Ambulatory area	–32.02 (128.18 to 170.91)		–20.28 (–27.53 to –13.04)			
JDT item—'Comm.'		0.02			–	–
Zero to mild	Ref		Ref			
Moderate	11.08 (–1.52 to 23.68)		–4.53 (–11.35 to 2.29)			
High to complete	17.33 (0.81 to 33.86)		–8.75 (–18.37 to 0.8)			
JDT item—'ABC'		0.34				
Zero to mild	Ref		Ref		Ref	
Moderate	4.61 (–6.37 to 15.60)		–7.78 (–15.84 to 0.28)		–8.52 (–16.85 to –0.19)	
High to complete	111.44 (91.36 to 131.53)		–12.21 (–33.40 to 8.98)		26.93 (5.67 to 48.18)	
JDT item—'Mobility'		0.34				
Zero to mild	Ref		Ref		Ref	
Moderate	4.61 (–6.37 to 15.60)		–7.78 (–15.84 to 0.28)		–8.52 (–16.85 to –0.19)	
High to complete	111.44 (91.36 to 131.53)		–12.21 (–33.40 to 8.98)		26.93 (5.67 to 48.18)	
JDT item—'Needs'		0.44	Not included	–	–	–
Zero to mild	Ref		(Perfect multicollinearity)			
Moderate	16.39 (1.25 to 31.52)					
High to complete	176.49 (150.50 to 202.47)					
JDT item—'Safety'		0.23	Ref	–	–	–
Zero to mild	Ref		2.83 (–7.86 to 13.53)			
Moderate	15.36 (2.56 to 28.15)		–42.49 (–72.49 to –12.49)			
High to complete	79.43 (59.93 to 98.94)					
JDT item—'Triage Lvl'		0.41				
Moderate	Ref		Ref	–	–	–
Zero to mild	–20.08 (–27.18 to –12.99)		2.83 (–7.86 to 13.53)			
High to complete	61.36 (46.56 to 76.17)		–42.49 (–72.49 to –12.49)			

JDT, Jones Dependency Tool.

Nurse analyses (indirect care time)

The correlation between the median nurse's perceived workload assessment and the total care time of each 4-hour period shows a highly significant result ($p<0,05$). However, the correlation coefficient shows a moderate value at 0.72 with a wide 95% CI (0.52 to 0.85).

Association between patients and nurses' analyses (direct care time with indirect care time)

The total indirect care time was associated with the total direct care time with a Spearman correlation coefficient of 0.86 (95% CI 0.74 to 0.93).

Overall workload analyses (total care time)

The univariate linear regression model, with the total time spent on nursing care per WANE as the dependent variable and the number of patients managed as independent variable, revealed a β=45.22 (95% CI 36.98 to 53.46) and an overall R^2 of 78%, showing that 78% of the variation in total care time is explained by the number of patients managed. This linear regression also shows that, for each additional patient, the total nursing care time increased by 45.22 min±8.24 min. In the hospitals without pre-established care area organisation, the R^2 was higher 83% (online supplemental appendix 1).

DISCUSSION

This study aimed to identify a simple method for assessing nursing workload in EDs, as calculating total workload is essential for determining appropriate nurse-to-patient ratios and ensuring optimal resource allocation.

First, we found a highly significant correlation between the number of patients cared for and the total nursing time. Interpretations of these results may, however, vary. One perspective supports the logical connection between each additional patient

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and increased nursing workload. However, each patient may not require the same amount of nursing time, challenging the assumption that patient numbers alone can accurately measure workload.[19] Additionally, research frequently uses metrics like length of stay and bed occupancy rates instead of directly measuring nursing time, sometimes assuming that 'patient overload' directly translates to 'work overload' without fully exploring this relationship.[20]

Nevertheless, our findings suggest that total nursing time for all patients present can be predicted by a single variable: the total number of patients cared for, regardless of their severity. The scientific literature generally considers the impact of patient overload on work overload but does not thoroughly investigate the direct link between these concepts. A recent study explored the link between ED crowding and nurses' perceived workload, suggesting that perceived workload can reliably assess overall workload.[21] However, no recent studies have directly linked the number of patients (admitted and present) to total nursing time in the ED. This insight could improve ED statistical calculations by focusing on the total number of patients cared for over a set period (eg, 24 hours), rather than just new admissions. Such an approach could help adjust staffing and skill-mix based on local conditions and patterns, including variable schedules and special events.

Using total patients present allows for retrospective assessment of nursing workload, which can be used for planning. Our results also suggest the feasibility of a prospective model for workload estimation. As shown in our multivariable model, triage information and two items from the Jones scale (Mobility and ABC) account for 67% of the variability for direct nursing time. Therefore, direct care time could potentially be estimated in real time at the point of triage. However, this model treats Jones scale subcategories as standalone variables. Existing studies typically assess the impact of the Jones scale and triage scales on workload separately, with varying definitions of workload. Further research is required to test the feasibility and accuracy of such an application in real-time settings. If validated, the identified links could facilitate real-time workload prediction based on triage data, helping adjust nursing resource allocation across different ED areas.

Looking ahead, this study opens new possibilities for evaluating nursing workload. It suggests exploring workload assessment through different methods, such as retrospective analyses or potentially future studies based on patient profiles. Efforts should continue to develop comprehensive recommendations for safe staffing with input from public health experts, focusing on factors like patient-to-nurse ratios and key indicators.[7 22] As ED work is a team effort, future studies should involve all relevant professionals—medical, nursing, logistical and administrative—to establish clear standards for quality and safety in EDs.[23]

Limitations

Caution is needed when interpreting the direct care time results. The study's design relied on a retrospective analysis. Four-hour observation periods led to some skew in patient profile analyses, with lower triage levels being overrepresented compared with higher levels. Some data from longer care episodes were excluded due to incomplete records. This might result in an underrepresentation of extended care episodes. The median direct nursing time per patient from the WANE scale (22 min (10–44.6)) appears higher than the median time found in this study (10.6 min (6–23.3)).[18] The Spearman coefficient between the complete JDT and direct nursing time is similar to that in the WANE study, and the median Jones scale score matches the University of Antwerp's findings.

Since the protocol and interpretation are specific to the Belgian model, caution is needed when applying these results to other countries. The study included only one tertiary hospital, which might limit the generalisability of some findings. Still, examining organisational features, like pre-established area of care, offers valuable insights for other tertiary hospitals. Moreover, observation periods were chosen based on practical considerations, not randomisation. Although spring and summer were not included, the main goal was to develop a simple method for assessing workload, not to measure it precisely.

CONCLUSIONS

Triage data provide straightforward elements that could be leveraged to evaluate the workload of each patient admitted to the ED. Combined with our reliable method based on the total number of patients cared for, this approach lays the foundation for establishing safe staffing standards both in Belgium and internationally

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Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Ethics approval This study involves human participants and was approved by Ethics Committee of the University Hospital of Liège on 26 July 2022, under reference 2022/194. Participants gave informed consent to participate in the study before taking part.

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ORCID iD

Méryl Paquay http://orcid.org/0000-0002-3979-558X

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