RESEARCH ARTICLE

Nursing errors in intensive care unit and their association with burnout, anxiety, insomnia and working environment: a cross-sectional study

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Abstract

Background: In intensive care units (ICU), commonly identified nursing errors may have a negative impact on short- and long-term patient outcomes. Current data is scarce regarding nurses' burnout, insomnia, and anxiety impact on medication and several other types of nursing errors. This study aimed to record the commonness of various nursing errors, including checking patient data, medication preparation and administration, and infection control measures. It also aimed to investigate if "nurse-related" or "ICU-related" features may be associated with nursing error occurrence.

Material-Methods: A sample of nurses employed in four Greek ICUs was evaluated using the self-completed Athens Insomnia Scale, the State-Trait Anxiety Inventory Form Y, and the Maslach Burnout Inventory. Moreover, we also recorded the sociodemographic characteristics of the ICU nurses, data regarding nursing errors and common practices, and variables regarding the working environment. We conducted a multinominal regression analysis to identify the variables independently associated with each error/mistake.

Results: Ninety ICU nurses from the 99 addressed returned the completed questionnaires. The most frequent mistakes referred to drug preparation and administration, with 43.3 % of nurses reporting being "always/very often" distracted when preparing a drug and 90 % that "half of the times" they administer medication at unscheduled hours, followed in frequency by errors regarding the proper use of antiseptic solutions. Medication errors were independently predicted by state anxiety, satisfaction regarding training, emotional exhaustion score, number of ICU beds, and weekdays off work per month. In contrast, errors regarding infection control were independently associated with weekdays off work per month.

Conclusion: Medication errors are the commonest type of nursing error. Although several risk factors have been identified, no universal "nurse-related" or "ICU-related" factor can predict all types of errors. HIPPOKRATIA 2022, 26 (3):110-117.

Keywords: Nurse, intensive care unit, error, mistake, questionnaire, burnout, anxiety, insomnia, satisfaction

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Introduction

Nursing approaches that prevent adverse events and errors are defined as patient safety measures, with prevention of hospital infections and medication errors included in this definition[1]. Recently, patient safety has grown into a global concern, as non-safety services have greatly burdened patients and the health system[1,2]. In Intensive Care Units (ICUs), where health professionals are coping with unpredictability and constant variability of clinical cases[3], errors/mistakes are of utmost importance, as they may increase the resources consumed, the hospital stay, the morbidity, and the mortality[4].

Working as a nurse in an ICU is a demanding task, characterized by an intense working environment, long working hours, and caring for patients in critical condition, which may require actions to be taken rapidly and precisely[3,5]. These characteristics pose a huge emotional burden to the health professionals involved[6] and may result in burnout, a work-related syndrome that results from prolonged exposure to job-related stressors[3,7]. An association between occupational increased anxiety and burnout in nurses has been reported in previously published studies[8]; emotional exhaustion of all burnout dimensions exhibited the strongest correlation to anxiety[9]. Although burnout presence has been associated with the conduction of medical errors among ICU physicians[9], data regarding ICU nurses is currently limited. Moreover, the potential association between nursing errors and the two

dimensions of anxiety (trait anxiety as a stable personality characteristic and state anxiety as a temporal reaction to a perceived threatening situation) has never been explored before.

Another issue that may be implicated with nursing errors is difficulty in sleeping. Due to the constant nursing shortage, nurses must work longer shifts and extra days to satisfy patient demand and provide the required shift coverage[10]; however, this has increased stress, fatigue, and sleep disruption[11-13]. Sleep disruption and deprivation may be associated with fatigue in the ICU environment that demands accurate and detailed patient care measures, leading to errors/mistakes that could negatively affect patient outcomes[13-15]. Although the association between errors and working night shift has been previously studied[15,16], data regarding the potential impact of insomnia and nursing errors in ICU are currently lacking.

Based on those mentioned earlier, this cross-sectional study aimed: a) to record the commonness of various nursing errors, including checking patient data, medication preparation and administration, and infection control measures, and b) investigate if "nurse-related" parameters (burnout, levels of state and trait anxiety, insomnia, and training satisfaction) or "ICU-related" features may be associated with the conduction of nursing errors.

Material-Methods

This study, designed as a cross-sectional, multicenter, non-interventional study, was conducted in four adult (surgical or medical) ICUs in three general hospitals in Northern Greece. All employed nursing personnel (apart from training nursing students) who worked on shifts in these ICUs was considered eligible for study inclusion. The Ethics Committees of the participating institutions approved the conduction of the study ["Papageorgiou" Hospital Scientific Council (decision No 322, dated 29/11/2019), "G. Papanikolaou" Hospital Scientific Council (decision No 17, dated 20/11/2019), and "AHEPA" Hospital Scientific Council (decision No 1288, dated 19/11/2019)], and participation was voluntary.

Data collection

An adequate number of questionnaires and a detailed letter explaining the data collection procedure and the study purpose were mailed to the ICUs that participated in the study, addressing all employed nurses. Depending on the nurse's convenience, anonymized completed questionnaires (placed in provided sealed envelope) were collected from the ICUs by the first author or returned by mail to a predefined address, according to the previously described methodology[9]. The mailing and collection of questionnaires were conducted between the 28th of August and the 30th of September 2020. Three reminders were emailed to each ICU within three weeks to increase the response rate. Each study participant self-completed a single questionnaire, which consisted of the following five parts:

Part one recorded sociodemographic data, details regarding nurses' working experience, and data regarding the ICU type and structure (e.g., number of ICU beds, number of employed nurses, number of days off work per month, etc.).

Part two consisted of the Athens Insomnia Scale (AIS), a self-report questionnaire with eight items (AIS-8) measuring sleep difficulties intensity according to the diagnostic criteria for insomnia of the International Statistical Classification of Disease and Related Health Problems-10th Revision (ICD-10)[17,18]. AIS has been translated and validated for the Greek population[18]. The first five items refer to sleep induction, awakenings during the night, total sleep duration, final awakening, and sleep quality, while the last three items refer to functioning capacity, well-being, and sleepiness during day time. Participants are questioned whether they experienced sleep difficulties at least three times/week during the last month. Each of the eight items is rated on a four-point Likert-type scale (ranging from zero, meaning no problem at all, to three, indicating very serious problems). Total scores range from zero to 24, and higher scores indicate responders have severe insomnia problems (reported Cronbach's alpha is 0.90)[17,18]. An AIS-8 cut-off score of six or more is utilized to establish the diagnosis of insomnia[19].

Part three was the State-Trait Anxiety Inventory (STAI) Form Y[20], a self-completed questionnaire with 40 items rated on a 4-point Likert-type rating scale[9]. STAI Form Y is subdivided into two subscales, STAI Form Y-1 consisting of 20 items measuring transient stress (state anxiety), meaning the stress experienced at the time of the survey, and STAI Form Y-2 consisting of another 20 items measuring permanent stress (trait anxiety), denoting stress as a personality trait. For each subscale, the total score ranges from 20 to 80; the higher the score, the higher the stress. The scoring weights for the anxiety-present items are the same as the blackened numbers on the test form, while the scoring weights for the anxiety-absent items are reversed[9,20]. The STAI has been previously translated and validated for the Greek population (Cronbach's alpha being 0.93 for the state and 0.92 for the trait subscale)[21].

Part four consisted of the Maslach Burnout Inventory-Human Services Survey© (MBI-HSS), used following a license granted from Mind Garden. MBI-HSS is a self-completed questionnaire of 22 items, assessing the three dimensions of burnout: emotional exhaustion (EE; nine items), depersonalization (DEP; five items), and personal accomplishment (PA; eight items). Each item is scored on a seven-point Likert-type rating scale (Cronbach's alpha is 0.86)[9,22]. The MBI evaluates healthcare professionals' perceptions, attitudes, and feelings regarding their work environment. It has high reliability and validity[7] and is the most widely utilized measure of assessing burnout levels. It has been translated and validated for the Greek population[23]. The cut-off values that were utilized to define the low, moderate, and high degrees of each burnout dimension are the following: EE: high ≥27, average: 26-17, and

low ≤16; DEP: high ≥13, average: 12-7, and low ≤6; PA: high ≤31, average: 32-38, and low ≥39. High, moderate, and low levels of burnout are indicated by high, moderate, and low levels of EE or DEP, or low, moderate, and high levels of PA[3].

Part five comprised of eleven questions that recorded nursing errors regarding infection control (three questions), drug preparation and administration (three questions), patient data checking (two questions), recognition and report of errors made by co-nurses (two questions), and a last question regarding the participant's feeling after the commitment of the error. The participants rated each circumstance by frequency of occurrence (always, very often, half of the times, rarely, never). The type of questions and scoring scale were selected based on previous publications on nursing errors in Greece[24] or elsewhere[25].

Statistical analysis

All analyses were conducted using the PASW Statistics for Windows, Version 18.0 (SPSS Inc., Chicago, IL, USA). The normality of the distribution of values was assessed utilizing the Shapiro-Wilk test, where $p < 0.05$ indicated a normal distribution. The continuous variables are presented as means with standard deviation or medians with minimum-maximum values, depending on their distribution, while categorical variables are presented as percentages. The Shapiro-Wilk normality test was applied to test the variable distribution of values. Independent samples Student's t-test, one-way Analysis Of Variance (ANOVA), Mann-Whitney U test, and Kruskal-Wallis test were applied to compare continuous variables across frequency groups of nursing errors, according to the distribution of their values; the Tukey test was applied for *post hoc* analysis with one-way ANOVA. The Chi-square or Fisher's exact test was used to compare categorical variables across frequency groups of nursing errors. Multinomial logistic regression analysis was applied for each error which was found to be associated with more than one categorical or continuous variable. Exp(B) with the corresponding 95 % confidence interval (95 % CI) was calculated for all multivariate predictors. A $p < 0.05$ level was considered significant for all analyses.

Results

Ninety completed anonymized questionnaires were returned out of 99 sent, which corresponded to a response rate of 90.9 %. Respondents included 16 men (17.8 %) and 74 women (82.2 %) with a mean age of 41.6 ± 7.2 years. The baseline characteristics of participants are presented in Table 1.

Frequency of nursing errors

Participants followed established rules regarding infection control (change gloves, wash hands, use antiseptic solution), drug preparation and administration (drug dosage, scheduled time of administration, drug preparation procedure), and checking the patient's data (name and drug sheet) with various frequency; data are presented in Table 2. The most frequent mistakes referred to drug preparation and administration. Thirty-nine nurses (43.3 %) stated being "always/very often" distracted while preparing a drug. Only four (4.4 %) nurses reported "rarely/never" administering drugs at a wrong dosing hour; on the contrary, five (5.6 %) reported "always/very often" doing that, and the rest, 81 nurses (90 %) reported doing this error "half of the times". The less frequent error regarding drug administration referred to the wrong dosage, as 84 participants (93.3 %) reported "rarely/never" conducting this error. Errors regarding infection control procedures and checking patient data were less frequent, as presented in Table 2.

Identifying any errors made by co-workers was also frequent; 45 participants (50 %) identified such errors half of the time, while another 12 (13.3 %) "always/very

Table 1: Baseline characteristics of the study's sample consisting of 90 nurses working in Greek intensive care units who participated in the cross-sectional non-interventional study investigating the frequency of various nursing errors and their association with "nurse-related" and "ICU-related" features.

Variable	Study participants
Age (y)	41.6 ± 7.2
Gender (n, %)	
-male	16 (17.8%)
-female	74 (82.2%)
Marital status	
-single	20 (22.2)
-married/with partner	64 (71.1)
-divorced/separated	6 (6.7)
Number of underaged children	2 (0-3)
Working experience in ICU (y)	12.7 ± 7.7
Level of training satisfaction	2.2 ± 0.8
Number of nurses/ICU	29 ± 8.6
Number of beds/ICU	10.8 ± 2.2
Morning shifts/week	2.7 ± 1.2
Evening shifts/week	2.3 ± 1
Night shifts/week	1.9 ± 0.6
Days off work/month	7 ± 1.3
AIS score	6 (0-14)
State anxiety score	40.1 ± 12.5
Trait anxiety score	44.1 ± 9.3
High EE (n, %)	55 (61.1)
High DEP (n, %)	26 (28.9)
Low PA (n, %)	29 (32.2)
High burnout (n, %)	75 (83.3)

Values are presented as means with standard deviation or number with percentage in brackets (where indicated). ICU: Intensive Care Unit, AIS: Athens Insomnia Scale, EE: Emotional Exhaustion, DEP: Depersonalization, PA: Personal Accomplishment.

Table 2: Reported frequencies of studied nursing practices and errors in the four Greek intensive care units included in the study.

	frequency of reported occurrence		
Nursing practice	**always/very often**	**half of the times**	**rarely/never**
Changing gloves*	98.9 (89)	0	1.1 (1)
Washing hands*	90 (80)	10 (9)	0
Use of antiseptic solution*	85.5 (77)	7.8 (7)	6.7 (6)
Administer wrong drug dosage	5.6 (5)	1.1 (1)	93.3 (84)
Administer a drug at wrong hour	5.6 (5)	90 (81)	4.4 (4)
Being distracted while preparing a drug	43.3 (39)	26.7 (24)	30 (27)
Check patient's name prior administering a drug	95.6 (86)	0	4.4 (4)
Check drug sheet prior administering a drug	98.9 (89)	0	1.1 (1)
Identifying errors of co-workers	13.3 (12)	50 (45)	36.7 (33)
Reporting perceived errors to co-workers	36.6 (33)	35.6 (32)	27.8 (25)

Values are presented as number with percentage in brackets, *: According to Intensive Care Unit's infection control protocol.

often" identified them. However, 25 nurses (27.8 %) "rarely/never" report these mistakes to their co-workers, while another 33 (36.6 %) stated that they "always/very often" do report them (Table 2). The most common feeling after realizing a mistake was stress, which was reported by 20 nurses (22.2 %), followed by disappointment (n =15; 16.7 %), and fear (n =11; 12.2 %).

Nursing errors and Insomnia

The median AIS score among participants was six (0-14); a high AIS score, compatible with insomnia, was present in 45.6 % of participants. Neither the AIS score nor the presence of insomnia was associated with a higher frequency of committing any error. However, patients with insomnia reported that they detected "always/very often" mistakes committed by co-workers in a higher percentage than the rest (23.3 vs 2.8; p =0.028).

Nursing errors and Anxiety

The State anxiety score was 40.1 ± 12.5, and the Trait anxiety score was 44.1 ± 9.3. No differences were noted regarding either STAI state or STAI trait scores between the frequency of changing gloves from one patient to another, washing hands, administering a drug at the wrong hour, administering a drug in the wrong dosage, checking the patient's name and drug sheet, noticing other nurses' mistakes, and talking to co-workers about their mistakes. However, nurses who "always/very often" used antiseptic solution versus those who used it "rarely/never" had lower levels of STAI State score (39.5 ± 12.3 vs 63.5 ± 0.7; p =0.024) and lower levels of STAI Trait score (43.6 ± 9 vs 60 ± 12.7; p =0.042). Moreover, nurses who reported being "always/very often" distracted while preparing a drug had significantly higher levels of STAI State score compared to those who reported being "rarely/never" distracted (43.7 ± 12.2 vs 36.9 ± 12.8; p =0.039). No difference was noted in the State-Trait score regarding distraction.

Nursing errors and Burnout

The total scores for each burnout dimension were 31.9 ± 11.5 for EE, 8.7 ± 6.2 for DEP, and 34.3 ± 8.8 for PA. Approximately 61 % of nurses (n =55) presented with high EE levels, 28.9 % (n =26) with high DEP levels, and another 32.2 % (n =29) with low PA levels. Overall, 83.3 % of participants (n =75) presented with a high risk of burnout. No differences were noted in nursing error frequency between participants with or without a high risk of burnout overall. However, nurses who administered drugs in the wrong dosage more frequently had higher EE scores than the rest ("always/very often" vs "rarely/never"; p =0.023).

Nursing errors and Health professional characteristics

Although no differences were noted in age and working experience regarding the frequency of conducting any error, the nurses who "always/very often" reported to their co-workers the mistakes they noticed were significantly older (43.3 ± 6.5 vs 38.8 ± 8.1 years; p =0.017), and they had longer working experience in ICUs (15.6 ± 8.1 vs 8.6 ± 6.5 years; p <0.001), compared to those who "rarely/never" did it. Marital status had some effect, as 33.3 % of divorced/separated reported to administering drugs "always/very often" in the wrong dosage, compared to only 4.1 % of married participants (p =0.028). In contrast, the number of underage children was not associated with any nursing error. Satisfaction regarding the level of training was lower among nurses who reported "always/very often" administering a drug in the wrong dosage (2.1 ± 0.7 vs 3.2 ± 0.8; p =0.001) and "always/very often" at the wrong hour (2.1 ± 0.8 vs 3 ± 0.9; p =0.017), compared to those who "rarely/never" made these errors. Moreover, satisfaction regarding the level of training was lower among nurses who "rarely/never" noticed mistakes done by co-workers (1.9 ± 0.6 vs 2.8 ± 0.9; p <0.001), compared to those who "always/very often" noticed them.

Nursing errors and ICU characteristics

The number of nurses per ICU, number of beds per ICU, number and type of shifts, and number of weekdays off work were examined. The number of weekdays/month off work was significantly lower among those who reported "rarely/never" using an antiseptic solution, com-

pared to those who reported "always/very often" using it (6 ± 1 vs 11 ± 2; p =0.003). It was also significantly lower among those nurses who reported "always/very often" being distracted when preparing a drug, compared to those who were "rarely/never" distracted (10.3 ± 2.3 vs 11.8 ± 1.1; p =0.017). Moreover, the number of ICU beds was reported higher among nurses who were "always/very often" distracted compared to those who were "half of the times" distracted (11.8 ± 1 vs 10.4 ± 2; p =0.017).

Multinomial regression analysis

A multinomial regression analysis was conducted for all nursing errors where differences in the frequency of occurrence ("always/very often" vs "half of the times" vs "rarely/never") were associated with more than one factor (Table 3). The frequency category "rarely/never" was used as the reference one, and comparisons were made to "always/very often" or to both "always/very often" and "half of the times" categories, depending on the findings of baseline comparisons. The first regression analysis referred to antiseptic use. The number of weekdays off work/month was the only independent predictor identified (p =0.016). A second regression analysis was conducted for distraction during drug preparation. The number of weekdays off work/month was negative, and the STAI State score and the number of ICU beds were positive independent predictors of its occurrence (Table 3). Another regression analysis was conducted for administering the wrong drug dosage; EE score and level of satisfaction regarding training were both independent predictors of this error (Table 3). The final analysis was conducted regarding reporting mistakes to co-workers. The years of working experience was the only independent predictor identified (Table 3).

Discussion

In this cross-sectional study, we aimed to identify the prevalence of several nursing errors and the potential factors that might affect their occurrence. Drug preparation and administration errors were the most common,

Table 3: Multinomial regression analysis of predictors associated to nursing practices and errors in the four Greek intensive care units included in the study.

Multinominal predictor of appropriate antiseptic solution use			
Variable	Exp(B)	95% Confidence Interval	p
Weekdays off work/month			
-always/very often	2.216	1.159 - 4.236	0.016
-rarely /never	reference category	reference category	reference category
Multinominal predictors of administering wrong drug dosage			
Variables	Exp (B)	95% Confidence Interval	p
EE score			
-always/very often	1.018	1.005 - 1.121	0.048
-rarely/never	reference category	reference category	reference category
Satisfaction of training level			
-always/very often	4.019	1.315 - 12.288	0.015
-rarely/never	reference category	reference category	reference category
Multinominal predictors of distraction during drug preparation			
Variables	Exp (B)	95% Confidence Interval	p
Number of ICU beds			
-always/very often	1.832	1.168 - 2.873	0.008
-half of the times	1.168	0.912 – 1.497	0.219
-rarely/never	reference category	reference category	reference category
Number of weekdays off work/month			
-always/very often	0.661	0.440 – 0.991	0.045
-half of the times	0.678	0.435 – 1.057	0.086
-rarely/never	reference category	reference category	reference category
State Anxiety Score			
-always/very often	1.061	1.014 – 1.111	0.011
-half of the times	1.041	0.987 – 1.097	0.139
-rarely/never	reference category	reference category	reference category
Multinominal predictors of reporting errors to co-workers			
Variable	Exp (B)	95% Confidence Interval	p
Years of working experience in ICU			
-always/very often	1.187	1.066 – 1.323	0.002
-half of the times	1.058	0.952 – 1.176	0.299
-rarely/never	reference category	reference category	reference category

EE: emotional exhaustion, ICU: Intensive Care Unit.

followed by errors regarding infection control measures and checking patient data. Several factors, including socio-demographic variables, working environment, and personality characteristics, were examined; however, different mistakes were associated with various risk factors, and no parameter was identified as a universal risk factor for all or most errors. The number of weekdays off work and the state anxiety score independently predicted distraction during drug preparation, one of the most common errors identified.

In this study, errors were frequent, confirming published literature on the topic. Previously, Eltaybani et al[26] reported 300 errors of various types conducted by 112 critical care nurses, of which 40 % contributed to significant harm or death of the patient. In another study conducted in an ICU, the frequency of medication errors was 9.4 % during 524 preparations and administrations of intravenous drugs[27]. Medication errors were the most common in our study, as more than 95 % of critical care nurses reported mistakes regarding medication dosage or administration time. On the other hand, errors/mistakes regarding checking patients' names and drug sheets were the least frequent. Similarly, in a previous multicenter study, Anselmi et al[28] indicated that while wrong dose and omission dose were the most frequent errors noted, drug administration to the wrong patient did not occur in any of the hospitals involved. Moreover, in our study, hand washing and changing gloves errors were very infrequent, while most errors regarding infection control measures referred to the proper use of the antiseptic solution. These findings agree with previous literature; Mahomed et al recently indicated that while adherence to handwashing was 100 % among ICU healthcare workers, proper use of alcohol rub was much lower[29].

Several "intrinsic" factors related to healthcare professionals' personalities have been previously assessed as potential risk factors for error occurrence in healthcare facilities. In a previous study, West et al confirmed an independent association between distress and self-perceived errors among physicians[30]. At the same time, a recent meta-analysis found strong evidence between burnout, sleepiness, depression, and the conduction of medical errors among hospital physicians[31]. However, data regarding nurses are currently limited; a positive relationship has been established between occupational stress and burnout and the perception of safety environment[32,33], but further research is needed. Surprisingly, in our study, a high risk of burnout overall (presence of high EE or high DEP or low PA) was not associated with the conduction of nursing errors; this might be partially explained by the fact that only a small portion of participants (less than 17 %) did not establish a high risk of burnout, so comparisons were made between groups with significant size differences. However, a higher EE score alone was an independent predictor of administering the wrong drug dosage, confirming previous data where EE was an independent predictor for overall patient safety among critical care nurses[34].

Other participants-related factors that might affect the frequency of nursing errors were anxiety and satisfaction regarding training level. In our study, state anxiety (transient stress) was an independent predictor of frequent distraction during drug preparation; however, trait anxiety (permanent stress as a personality characteristic) was not associated with a higher frequency of any nursing error. Stress is a well-known risk factor for nursing errors[35]. It has been previously reported that extrinsic effort, job demands, and over-commitment were associated with higher levels of anxiety in a population of nurses[36]. At the same time, stress reduction techniques may be useful in reducing nursing errors[37]. Nevertheless, a distinction between "types" of anxiety and their specific effect on nursing errors has not been previously investigated. In our study, lower levels of satisfaction regarding training independently predicted the administration of the wrong drug dosage and were also associated with a higher frequency of wrong hours of drug administration. Previous data indicated that specific training might increase nurses' knowledge and skills, reducing medication errors and improving skills in patient care[38]; however, the optimal tool for assessing training level and nurses' satisfaction needs to be further investigated.

Although more than 45 % of nurses presented with insomnia, no association was documented with any nursing error/mistake. It is assumed that in an environment requiring specific patient care measures, sleep deprivation and fatigue can affect the quality of care delivered by critical care nurses, which might negatively impact patient safety[13,14]. However, in a previous observational study, self-perceived errors among Emergency Department nurses were associated with sleep quality but not with sleep quantity, as assessed by Actigraph the day before the 12-hour shift[13]. Thus, the lack of an evident association between difficulty sleeping and nursing errors in our study may be due to the utilization of an inappropriate tool; whether another questionnaire may be more effective in capturing any such association remains to be studied.

In our study, the most important parameter regarding ICU function associated with nursing errors was the number of weekdays off work per month. This parameter was a negative predictor of distraction during drug preparation ("always/very often" vs "rarely/never") and a positive predictor of antiseptic solution use, as needed ("always/very often" vs "rarely/never"). Heavy workload[39] and longer working hours[40] have been previously identified as risk factors for medication errors among both nurses and physicians. Moreover, working hard and for long hours is associated with high levels of stress and burnout[3,42], another two parameters that may further increase the risk of errors. Thus, specific measures should be undertaken to relieve heavy workloads and increase the number of days that critical care nurses may spend off work, as this could reduce the number of nursing errors.

Another interesting finding refers to reporting perceived errors. Wondmieneh et al previously indicated

that inadequate work experience was negatively associated with reporting medication errors among nurses, confirming our results[42]. In our study, the years of working experience in the ICU independently predicted this outcome. There are a lot of benefits in reporting nursing errors, including patient safety, promoting education and awareness, and improving internal processes[40]. However, the unequal status/position of the individual who made the error and the person reporting it, the inefficient reporting system, the fear of consequences, and administrative issues are the most important barriers in reporting the errors[40]. Therefore, continuous training, retaining more experienced nurses, and creating an enabling and supportive environment for nurses to report errors may be necessary steps in this direction.

This study carries certain strengths and limitations. The high response rate, the different types of nursing errors investigated, and the various "extrinsic" and "intrinsic" factors explored as potential predictors of nursing errors, with state and trait anxiety being investigated for the first time in literature, strengthen its novelty and results. The investigation was totally based on self-reports, and no other "countable" measure of nursing errors was utilized; Although self-report may carry subjective bias, especially regarding the error frequency, this method has been extensively used in the published literature to measure several outcomes. The number of questions that referred to each error category was somehow limited, but we aimed not to address many questions to increase the response rate. Moreover, the factors that may be related to reporting errors were not extensively investigated, as this was not the primary aim of this study.

In conclusion, errors conducted by critical care nurses are not uncommon, and they most frequently refer to medication preparation and administration. Both "nurse-related" factors, high EE, high transient anxiety, and low satisfaction regarding training, and "ICU-related" factors, the number of weekdays off work per month, significantly affect various nursing errors. Using checklists comprising explicit step-by-step instructions has been found to be helpful in avoiding specific errors/mistakes, especially when a care provider is required to perform a long series of mechanistic tasks under a high cognitive load[43]. A multidisciplinary approach, including better training, more days off work, and specific measures to relieve burnout, are also needed to ensure better outcomes.

Conflict of interest

Nothing to declare for any of the authors.

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