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Nurses' intention to leave, nurse workload and in-hospital patient mortality in Italy: A descriptive and regression study.

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ABSTRACT

Higher nurse-to-patient ratios are associated with poor patient care and adverse nurse outcomes, including emotional exhaustion and intention to leave. We examined the effect of nurses' intention to leave and nurse-patient workload on in-hospital patient mortality in Italy.

A multicentered descriptive and regression study using clinical data of patients aged 50 years or older with a hospital stay of at least two days admitted to surgical wards linked with nurse variables including workload and education levels, work environment, job satisfaction, intention to leave, nurses' perception of quality and safety of care, and emotional exhaustion. The final dataset included 15 hospitals, 1046 nurses, and 37,494 patients.

A 10 % increase in intention to leave and an increase of one unit in nurse-patient workload increased likelihood of inpatient hospital mortality by 14 % (odds ratio 1.14; 1.02–1.27 95 % CI) and 3.4 % (odds ratio 1.03; 1.00–1.06 95 % CI), respectively.

No other studies have reported a significant association between intention to leave and patient mortality. To improve patient outcomes, the healthcare system in Italy needs to implement policies on safe human resources policy stewardship, leadership, and governance to ensure nurse wellbeing, higher levels of safety, and quality nursing care.

1. Introduction

Globally, evidence developed in the last decades shows that a better nursing work environment and nurse-patient workload improve patient outcomes [1–4]. In 2007, a meta-analysis confirmed the correlation between appropriate staffing and lower odds of inpatient mortality [5]. In 2008, the Communication on Patient Safety of the European Commission estimated that between 8 % and 12 % of hospitalized patients in the European Union were exposed to adverse events related to safety of care [6].

Although healthcare is going through many transformations including technology and organization, nurses have a crucial role of surveillance, by screening and monitoring patients at their bedside. A large body of evidence was developed showing that increasing numbers of patients per nurse threaten the quality of nurse surveillance [1-3,7,8].

Effects of poor nurse-to-patient staffing ratios showed higher levels of inpatient mortality [9] and negative outcomes for nurses. Also, surgical patients in hospitals with good work environments had 15 % reduced odds of death and 16 % lower odds of admission to the intensive care unit [4].

In 2018, a meta-analysis showed that a higher nurse-to-patient ratio was associated with adverse nurse outcomes, including burnout, job dissatisfaction, intention to leave [10]. More specifically, increased burnout in healthcare professionals was linked to lower healthcare quality and decreased patient safety [11]. Robust evidence showed that good work environments were associated with a 16 % increase in patient satisfaction and an 8 % decreased chance that a patient would experience an adverse event or death. Better work environments reduced the likelihood of job dissatisfaction, burnout, and intention to leave by 28 % to 32 % for nurses [12].

To date, no studies have explored the association between 'intention to leave' and 30-day in-hospital patient mortality. Therefore, we directly

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examined the effect of nurses' intention to leave and nurse-patient workload on 30-day in-hospital patient mortality in Italy through an observational study and according to the Aiken's theoretical framework [13], where the variations in the nurse and patient outcomes are linked to resource adequacy, nurse autonomy, nurse-patient ratios, nurse-physician relations, and nurse leadership

2. Methods

2.1. Data

We considered the administrative and clinical data, as well as the data of the RN4CAST@IT survey of clinical nurses [14]. Thus, we included data of patients admitted to surgical wards in 25 Italian public hospitals in 2015. In Italy the Diagnosis Related Group (DRG) payment system is implemented across all hospitals, including university hospitals, whereas global budget financing is predominantly utilized for hospital facilities affiliated with local health authorities. The RN4CAST@IT survey of clinical nurses included staffing, nurse workload, percentage of nurses with a bachelor's degree, the Practice Environment Scale of the Nursing Workforce Index (PES-NWI) score, job satisfaction, intention to leave, nurses' perception of quality and safety of care, and burnout in terms of Emotional Exhaustion (EE) (i.e., EE is a subscale of the Maslach Burnout Inventory and a score of 27 or higher indicates severe burnout [14]. We assumed that the functional nursing care model (i.e. standardized task-oriented) was predominant in Italy [15].

The administrative and clinical data were provided by two Italian Regional Healthcare Systems and included patient-level administrative data (e.g., age of patients, patient length of stay, and ward admission), clinical data (e.g., DRGs and the 9th version of the International Classification of Disease (ICD-9-CM) code for diagnosis. The distinction of primary and secondary diagnosis codified with ICD-9-CM, was not reliable. Hence, we considered all the diagnoses together without any distinction in the ICD-9-CM codes.

The analyses included patients aged 50 years or older with a hospital stay of at least two days, who had undergone surgery, similarly to the approach presented in previous studies [1,13]. The data preparation process reduced the number of included observations to have complete information; three observations were excluded for longer length of stay (higher than 365 days). Age, length of stay, ICD-9-CM, DRG, discharge status, hospital, and ward were all complete information that we included. Patient sex was excluded in the analysis as the missing values were around 40 % of the overall observations. The type of admission to hospital (e.g., elective, or urgent) were not available from the original dataset.

In addition, we grouped the 25 hospitals into 15 hospital organizations, including the substructures located in separate buildings, but belonging to the same hospital organization; for example, the hospital organization ID 7 consisted of three buildings located in three different areas of a large city (with more than 500,000 inhabitants). For each hospital, the dataset included information about the number of beds available, hospital technology (i.e., identified as high technology hospitals if performing open heart surgery and/or organ transplantation), and a variable indicating if the hospital conducted teaching activities [14]. Since only one teaching hospital was in the dataset, this information was not used in the subsequent analyses. The final dataset included 15 hospitals, 1046 nurses, and 37,494 patients. The administrative data included information about the patients admitted to the hospital and the corresponding unit, while the nurse survey data had the answers of the nurses who worked in specific hospitals and units. The matching was done using the hospital and the unit where the patient was admitted, and the nurse was working.

2.2. Patient outcomes and characteristics

Patient mortality was taken from the hospital discharge data. The dataset considers both elective and emergency patients admitted to surgical wards in 2015. The mortality rates in each hospital and in each ward in the dataset are shown in Appendix 1, while the relationship between mortality and the total number of patients treated in each hospital is shown in Fig. 1 (see Appendix 2).

To have enough data for each category, the ICD-9-CM codes were grouped into the following categories: 1) neoplasms, 2) circulatory system, 3) digestive system, 4) musculoskeletal system and connective tissue, 5) injury and poisoning, and 6) other diseases. Similarly, DRGs were grouped into two categories: 1) general surgery and 2) orthopaedic, vascular, and other surgery.

Comorbidities were not directly included in the dataset, therefore, to add comorbidities and patient chronic diseases to our study, we evaluated additional clinical information to detect the presence of chronic diseases (e.g., DRG, diagnosis and intervention). Chronic diseases were grouped into five categories: 1) None, 2) Cancer, 3) Diabetes, 4) Cardiovascular, and 5) Other chronic diseases (see Appendix 3). It should be noted that 1049 patients (2.8 % of the patients in the dataset) belonged to two categories, because they had two chronic diseases.

Every hospital included in our analysis had 100 or more beds available. The outcome measure considered in this study was the hospital patient mortality within 30 days of admission.

3. Nurse survey

Nurse staffing, nurse workload, and nurse education measures were drawn from the responses to the nurses' RN4CAST survey. In line with the RN4CAST study protocol [14], to describe the nurse workload, nurses were asked to indicate the number of patients cared for during the most recent shift. The nurse staffing in terms of nurse-to-patient ratio was computed by dividing the number of patients by the number of registered nurses present in the clinical unit. For this study, we assumed that the last shift was representative of a typical working day. Nurse education was calculated as the percentage of all registered nurses with at least a Bachelor of Science in Nursing (BSN) degree. Intent to leave was measured through survey items asking nurses if they intended to leave their job in the next year. The 5-subscale PES-NWI investigated through 31 items anchored to a 4-point Likert scale (from 1=strongly disagree to 4=strongly agree) the level of agreement with respect to the

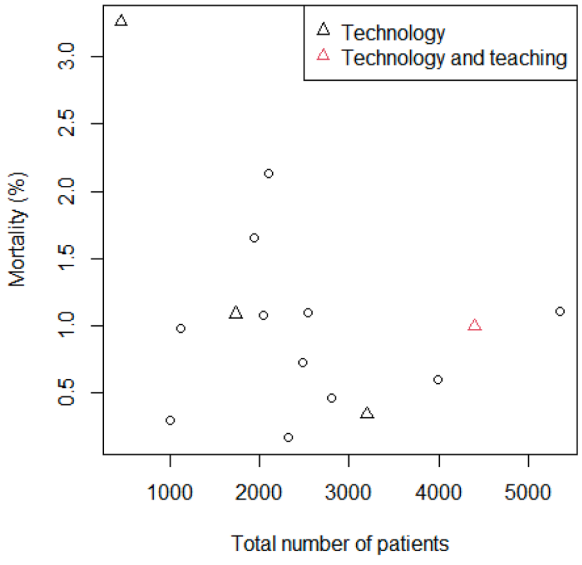

Fig. 1. Patients treated and mortality per hospital.
Triangles indicate hospital technology[a], while red triangles indicate the teaching hospital[b].
[a]hospital technology: open heart surgery and/or organ transplantation
[b]teaching hospital: having residents and/or fellows.

presence of some organizational characteristics of the work environment in the healthcare context that facilitate or hinder nursing practice. The PES-NWI composite score was calculated as the mean of the subscale means [16]. All the nurse indicators were computed averaging responses across all respondents at hospital and ward level (Appendix 4). Note that some of the 8 wards were only available in a subset of the 15 hospitals. As a results, the analysis included 43 wards (out of a total of 15 × 8 = 120). The survey was administered between September and December 2015.

3.1. Statistical analyses

We developed a statistical model to investigate the possible association between nurse staffing, nurse workload and working hours, nurse education, nurses' intention to leave, the PES-NWI composite score, and 30-day inpatient mortality for patients admitted to hospital wards in the two Italian regions and risk-adjusting for differences in patient characteristics (age, length of stay, ICD-9-CM code for diagnosis, DRGs, and comorbidities). The hospital characteristics included the number of beds and the technology level [14]. The employment of the PES-NWI composite score instead of the five single PES-NWI scores was supported by a principal component analysis, which showed that the first component was almost perfectly correlated with the PES-NWI composite score (with a 98 % correlation; see Appendix 3).

Mixed-effect logistic models were employed to assess the effect of the nurse indicators on the 30-day in-hospital mortality rate. The models considered hospitals and wards as additive random effects and included the above-mentioned characteristics of hospitals and patients, according to the simplification explained above (note that including both wards and DRGs is not redundant, since "General surgery" wards host more than 15 % of the patients with DRG "Orthopaedic, vascular and other surgery"; see Appendix 3). Note also that the model was fitted on the 37,494 patients (unit of analysis), each with its own characteristics (age, length of stay, etc.), while nurse variables were included at ward level (i.e., they were the same for all patients of the same ward). Model selection was performed with a forward approach based on Akaike's information criterion (AIC).

All statistical analyses were performed with R statistical software (version 4.0.4) using the lme4 and MuMIn packages [17,18]. The complete codes and results are available in Appendix 3.

3.2. Ethics

This study was approved by the local regional ethics committee (EU 2016/679).

4. Results

The patients' mean age was 70.7 years (± 11.18), and the median length of stay was 5 days (IQR 8) (Table 1). The total number of patients who died in the hospital within 30 days of admission were 348 (0.93 %) across all hospitals. Most of the patients were admitted either to general (38.4 %) or orthopedic (33.64 %) ward. Patients with no comorbidities were more than half of the sample (58.53 %).

We invited 1814 nurses; the respondents were 1518 (84 %). Analyses were conducted on 1046 surgical nurses. Most of the nurses were female (84 %) and the mean age was 41.9 years (± 8.7). Bachelor of Science in Nursing or higher degree was held by 45 % of the nurses. On average, each nurse cared for 17 (± 8.83) patients on their last shift. The average composite score of the work environment was 2.51 (± 0.52). Overall, 36 % of the participating nurses reported a high level of emotional exhaustion (score >27). The mean emotional exhaustion score was 22.9 (± 12.16). Nurses dissatisfied with their job in hospital were 36 %, and 30 % of nurses have expressed their intention to leave. Additionally, the patient safety grade was described as low or poor by 67 % of the respondents, while the quality of patient care was described as fair to low by 35 % of the nurses (Table 2). Fig. 2 (see Appendix 2) shows the relationships among nurse indicators and PES-NWI composite score. We observe that the only strong (negative) correlation is between intention to leave and PES composite score (r=−0.79). Staffing and nurse-patient workload are only slightly positively correlated (r = 0.34), while education and working hours are slightly negatively correlated (r=−0.34). Fig. 3 (see Appendix 2) reports the distribution of nurse indicators and

Table 1
Patient characteristics.

	Mean	St Dev	Median	IQR
Age (years)	70.72	11.18	71	17
Length of stay (days)	7.29	8.21	5	8
	N	%		
DRG				
DRG related to General surgery	10,244	27		
DRG related to Orthopaedic, vascular, and other surgery	27,250	73		
Ward				
Cardiology surgery	4061	11		
General surgery	14,398	38		
Thoracic surgery	378	1		
Vascular surgery	1242	3		
Orthopaedics surgery	12,612	34		
Gynaecology and obstetrics	909	2		
Ear, Nose and Throat (ENT)	150	0.4		
Urology	3744	10		
Hospital characteristics				
High technology hospital[a]	12,814	34		
Low technology hospital	24,680	66		
Chronic diseases (comorbidities)				
Patients with no chronic disease	21,946	59		
Patients with cancer	7943	21		
Patients with diabetes	1161	3		
Patients with cardiovascular diseases	6521	17		
Patients with other chronic diseases	972	3		
Main ICD group related to hospital admission				
ICD Group 1 Neoplasm	8499	23		
ICD Group 2 Diseases of the circulatory system	5505	15		
ICD Group 3 Diseases of the digestive system	6981	19		
ICD Group 4 Diseases of the musculoskeletal system and connective tissue	5054	13		
ICD Group 5 Injury and poisoning	7956	21		
ICD Group 6 Other diseases	3499	9		

[a] hospital technology: open heart surgery and/or organ transplantation.

Table 2
Nurse characteristics and work environment.

	N (%)	Mean	St Dev
Nurse characteristics			
Sex (female)	874 (84 %)		
BSN degree or higher	472 (45 %)		
Age (years)		41.9	8.7
Years as nurse		13.35	9.23
Work environment			
PES-NWI Composite Score		2.51	0.52
Workload		16.96	8.83
Staffing (nurse to patient ratio)		8.91	4.85
Working hours		8.11	2.39
Nurse's intention to leave	316 (30 %)		
Nurse dissatisfied with their job	379 (36 %)		
Nurse's emotional exhaustion		22.89	12.16
Nurse with high emotional exhaustion (Score >27)	380 (36 %)		
Patient safety grade (low-poor)	703 (67 %)		
Quality of patient care (fair-low)	371 (35 %)		

N = 1046.
PES-NWI: Practice Environment Scale Nursing Work Index (score ranges from 1 to 5; 5 domains scale).
BSN: Bachelor of Science in Nursing.

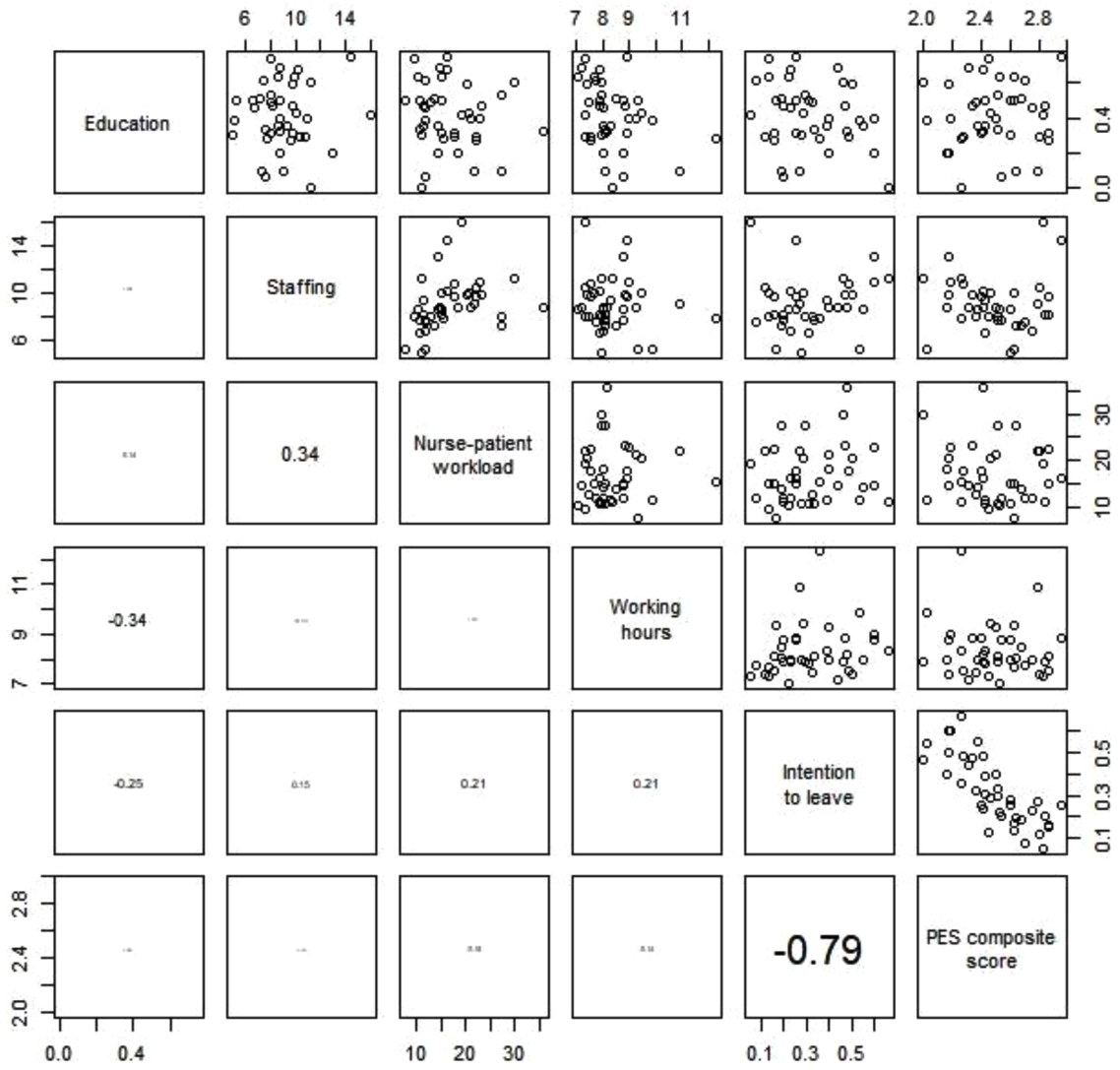

Fig. 2. Relationships among nurse indicators and PES composite score.
Scatterplots (upper-right panels) and correlations (lower-left panels) showing the relationship among nurse indicators and PES composite score.

PES-NWI composite scores with respect to mortality and shows that workload, intention to leave, and the PES-NWI composite score were strongly associated with patient mortality.

4.1. Model specification

AIC-based forward feature selection led to a final model explaining a large portion of the deviance (marginal R^2 34.17 %, conditional R^2 49.81 %). This model included the following eight fixed-effect predictors (in order of inclusion in the model): age, length of stay, DRG, ICD-9-CM, chronic diseases, nurse intention to leave, nurse-patient workload, and hospital technology (Table 3). Before building the model, we checked the relationship between the main variables (see Figure 2 in Appendix 2, and Appendix 3). The AIC-based forward selection included workload (and not staffing) in the model. Also, our data showed a strong negative correlation between intention to leave and PES-NWI composite score ($r = -0.79$), and only the former was selected by the AIC-based forward procedure. When the variable intention to leave was excluded from the possible predictors to be considered for building the model, then the AIC-based forward variable selection selected PES-NWI composite score instead of intention to leave, leading to a model with slightly smaller explanatory power (marginal R^2 34.16 %, conditional R^2 49.69 %; see Appendix 2). As expected, the coefficient of PES-NWI composite score was negative (OR 0.56; *t*-test p-value 0.054), while the one for intention to leave was positive (OR 1.14; *t*-test p-value 0.020). Eventually, the intention to leave variable was chosen over the PES-NWI composite score as it better explained the variance in patient mortality.

Importantly, intention to leave and workload had significant positive effects on the probability of 30-day in-hospital patient mortality. The results showed that higher intention to leave for nurses and higher nurse-patient workload were associated with higher probability of in-hospital mortality. In particular, the Odds Ratio (OR) associated to an increase of 10 % in the intention to leave was 1.14 (1.02–1.28 95 % CI) and the OR associated to an increase of one patient in the nurse-patient workload was 1.03 (1.01–1.06 95 % CI) (Table 3).

Age had a very strong effect, increasing the probability of death, as expected. Older patients had a higher probability of dying, with an OR 1.10 (1.09 - 1.12 CI 95 %). Patient length of stay also had an effect on likelihood of death. Patients who had a longer stay in hospital had higher odds of dying, OR 1.03 (1.03 - 1.04 CI 95 %).

Regarding clinical information, the model showed that orthopedic, vascular, and other surgery DRGs have a much higher probability of leading to death rather than general surgery, with an OR of 3.44 (2.44 -

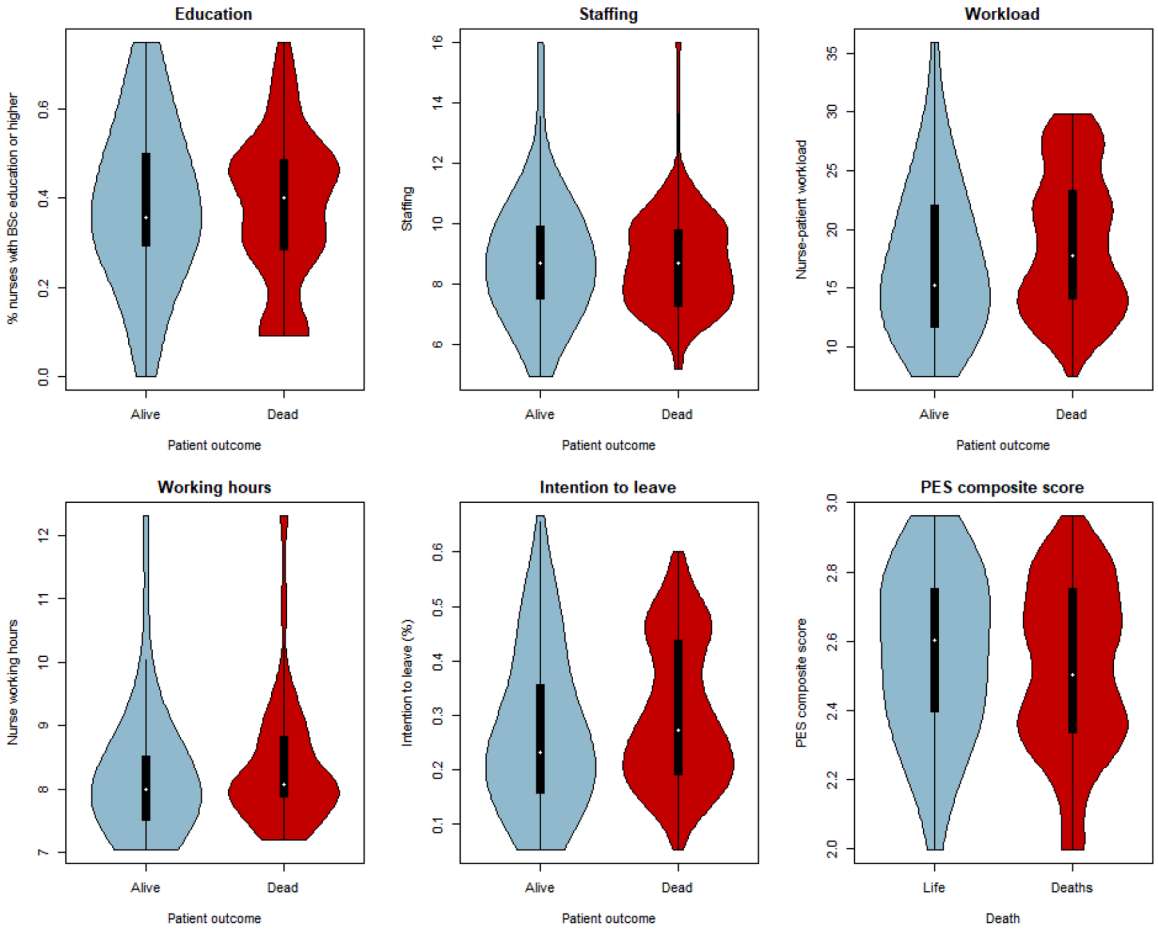

Fig. 3. Nurse indicators and PES composite score with respect to mortality.
Violin plots (with boxplots) showing the distribution of nurse indicators and PES composite score in alive (blue) and dead (red) patients.

4.85 CI 95 %). ICD-9-CM groups of diseases of the digestive system were more strongly associated with death than neoplasms. Moreover, ICD-9-CM groups of diseases of the circulatory system, injury and poisoning, and others were more strongly associated with death than neoplasms, while the ICD-9-CM group of diseases of the musculoskeletal system and connective tissue did not show a different likelihood of death with respect to neoplasms. The wards where patients were admitted were highly significant as a random effect, while the random effect of the hospitals was not significant in this model.

Considering the data related to chronic diseases, as expected patients with cancer had a much higher probability of dying than those with no chronic disease, with an OR of 3.39 (2.06 - 5.56 CI 95 %), while other chronic diseases had no effect on the likelihood of death.

Finally, high technology hospitals appeared to reduce patient mortality with respect to other hospitals, but the effect was not significant.

5. Discussion

To date, the RN4CAST@IT study is the only study ever conducted in Italy that used nurse outcomes (e.g., burnout, and intention to leave) and nurse workforce data (e.g., staffing, workload) to examine how these variables were associated with patient outcomes (e.g., patient mortality 30 days after admission). The data demonstrated a strong negative association between 'intention to leave' and work environment (PES-NWI score) variables, suggesting that hospital management strategies to ameliorate the quality of the nurse work environment could also result in a lower intention to leave. Also, our analysis showed that compared to work environment variables, the intention to leave better explained variability in patient mortality data. This suggests that, in our data, "intention to leave" is the most significant nurse outcome indicator associated to mortality.

Thus, this study revealed how 'intention to leave' was associated with patient mortality. This significant finding raises many concerns, because a 10 % increase in 'intention to leave' increased the likelihood of inpatient hospital mortality by 14 %. To the best of our knowledge, no other available studies have shown to date such a significant association between 'intention to leave' and patient mortality.

We found that an increase in nurses' workloads by one patient increased the odds of mortality by 3.4 %. This result agrees with a previous cross-sectional study conducted on a larger sample of surgical patients in nine European countries, where each additional patient to the nurse's workload increased the likelihood of inpatient mortality by 7 % [1]. More recently, similar findings have been described in the US focusing on in-hospital cardiac arrest. For example, McHugh et al. (2016) [19] reported that one-unit increases in workload determine a survival-to-discharge reduction by 5 %. Consistently, also in burn patients admitted to high-volume burn hospitals, it has been shown that adding one patient to a nurse's workload could increase the likelihood of mortality by 30 % [20].

These findings reveal the consequences of the 2008 financial crisis that determined in Italy, as in many other countries, a slowdown in the hiring of healthcare professionals – especially nurses due to ongoing budget cutting to the healthcare sector, due to a law that set tough rules about new hirings [21]. This is the real constraint with which healthcare systems are still facing. In fact, Italy spends only 8.8 % of its gross domestic product for the Italian National Healthcare System (NHS), and in the decade 2010–2019 the inflation grew on average by 1.07 % a year, whereas funding for the Italian National Health System grew on average

Table 3
Final mixed-effect logistic model showing the effect of study covariates on 30-day inpatient mortality.

Fixed effects Covariate	Estimate	Std. Error	p-value	OR	95 % CI
Intercept	−16.073	0.761	<0.001	–	–
Age	0.098	0.006	<0.001	1.10	(1.09, 1.12)
Length of stay	0.033	0.003	<0.001	1.03	(1.03, 1.04)
DRG Orthopaedic, vascular, and other surgery[1]	1.234	0.176	<0.001	3.44	(2.44, 4.85)
ICD group diseases of the circulatory system[2]	1.197	0.428	0.005	3.31	(1.43, 7.6 7)
ICD group diseases of the digestive system[b]	1.591	0.271	<0.001	4.91	(2.88, 8.35)
ICD group diseases of the musculoskeletal system and connective tissue[b]	−0.168	0.562	0.765	0.85	(0.28, 2.54)
ICD group injury and poisoning[b]	1.223	0.377	0.001	3.40	(1.62, 7.12)
ICD group Other[b]	0.880	0.361	0.015	2.41	(1.19, 4.90)
Comorbidity Cancer[3]	1.220	0.253	<0.001	3.39	(2.06, 5.56)
Comorbidity Diabetes[c]	−0.444	0.335	0.185	0.64	(0.33, 1.24)
Comorbidity Cardiovascular disease[c]	−0.105	0.180	0.560	0.90	(0.63, 1.28)
Comorbidity Other chronic disease[c]	−0.046	0.304	0.879	0.96	(0.53, 1.73)
Intention to leave	0.133	0.057	0.020	1.14	(1.02, 1.28)
Nurse patient workload	0.034	0.013	0.008	1.03	(1.01, 1.06)
High technology hospital	−0.307	0.195	0.115	0.74	(0.50, 1.08)
Random effects					
Group	Name	Variance			
Hospital	Intercept	0.04658			
Ward	Intercept	0.97840			
AIC	BIC	Log Likelihood	Deviance	Df. resid	
3241.6	3395.1	−1602.8	3205.6	37,476	

[1] Reference group: DRG General surgery.
[2] Reference group: ICD Neoplasm.
[3] Reference group: No comorbidities.

by 0.9 %/year [19]. Moreover, the differences in 'intention to leave' data between the USA (14 %) [22] and Italy (30 %) [23] may be due to fact that 'intention to leave' in Italy can be seen as a desire, as it requires long time and efforts to change workplace. Precisely, the Italian health system is public with a rigid public job market; to work in another hospital, Italian nurses have to pass an open competitive examination, which in addition to being quite difficult, does not occur frequently. Instead, in the United States, nurses are enrolled through job interviews, meaning that nurses have much more opportunities to change their workplace.

Our findings may indicate how austerity in economic policies not only damage patient outcomes but might have a negative impact on the professional development of nurses both in terms of career and economic progression, including the risk of making nursing a less appealing profession in the long run and generating job dissatisfaction. A recent report of the Organization for Economic Co-operation and Development (OECD) claims that although in the 2000′s there was an increase in the number of graduate nurses, in the last decade there has been a sharp drop of nursing students, a signal that nursing is becoming a less attractive profession [24]. More recently, the nursing shortage was highlighted during the pandemic, proving to be a greater limitation than the shortage of beds and intensive care services [25]. The OECD data show that, compared to a European average of 8.8 nurses per thousand inhabitants, Italy has only 6.2 nurses/1000 inhabitants. Furthermore, data on physicians show a completely opposite situation to that of nurses, in fact compared to a European average of 3.6 physicians/1000 inhabitants, Italy has 4.1 physicians/1000 inhabitants [25]. These differences suggest that these variations reveal the need to reach an improvement in skill mix. In 2019, the ratio of nurses to physicians in Italy was less than two nurses to every physician (1.5) compared to Europe where on average there were slightly less than three nurses for every physician (2.9) [25].

Data from the RN4CAST@IT survey [23] show that the numbers of nurses delivering direct patient care are insufficient and that those who were available, were experiencing a high level of burnout – emotional exhaustion (37.8 %) that is a pushing factor of 'intention to leave' together with understaffing and nurses' perception of poor patient safety [26]. The low patient safety perceived by the nurses may suggest the presence of moral distress which the literature indicates as one of the possible threats to the intention to leave [27]. Our results can provide insights in understanding the impact of the more recent events related to the COVID-19 pandemic, indeed, a recent systematic review, including 18,935 nurses conducted to examine the nurses' burnout and associated risk factors during the COVID-19 pandemic, reported a 34.1 % prevalence of emotional exhaustion [28]. In addition, in the context of the COVID-19 pandemic, Italian nurses suffered the huge impact of the pandemic on the nursing workforce [29]. Nurses' poor levels of well-being, combined with high workloads and poor work environment, heavily impacts on the ability to deliver high quality nursing care during the pandemic.

Hence, it is necessary to consider how to orient the healthcare system in Italy to reduce the workload and related negative nursing outcomes, such as burnout and 'intention to leave'. As specified in the "*Global Strategy On Human Resources For Health: Workforce 2030*" developed in 2016 by the World Health Organization [30] and the International Council of Nurses [31], it is necessary to develop and integrate recommendations that help hospital managers and healthcare ministers to concretely implement local policies aimed at developing a positive work environment where nurse workload is regulated through dedicated investments to guarantee nurse wellbeing, a higher level of patient safety, and better quality nursing care that would lead to positive impacts on patients' outcomes, including reduced mortality.

Currently, Italy is in a favorable condition given the availability of the Next Generation EU (National Recovery and Resilience Plan (NRRP) of the European Commission [32], which could be used to tackle some structural problems of the Italian NHS that stemmed from the economic crisis of 2008. For example, after NRRP investments are made, it would be necessary to invest on hiring more nurses to ensure better inpatient outcomes and continuum of care after they are discharged from hospital.

6. Limitations

This study had a few limitations mainly due to the cross-sectional design that does not permit to assume causality between intention to leave, workload and patient's mortality. Also, limitations result from limited dataset of our patients' hospital admission data, which included only two Italian regions out of a total of 20, and to the fact that data were collected in 2015. Our hospital data were from only two Italian regions, which provide similar levels of healthcare to the population in terms of quality, costs, and outcome. This might explain why the hospitals were not significant as a random effect in the final model. Including hospitals from other Italian regions in the dataset would probably enable to identify more differences between hospitals and to generalize the results to the entire Italian health system.

Also, this study comprised a limited number of hospitals and grouped substructures, thus hiding their heterogeneity, and reducing observable

differences among hospitals. Additionally, clinical adjustments included in the model may not represent all determinants of patients' mortality risk, hindering the assessment of the influence of the different features on patients' mortality. Another limitation is given by the identification of patient chronic diseases. The identification was performed through a validated method in Italy used by the Ministry of Health to identify patient diseases using administrative databases, mainly hospital admissions, emergency department admissions, drugs prescribed to patients, outpatient visits and electronic patient record. In order to better identify the disease a large period of analysis could be considered (more than five years) and in all the available databases, while in our study we have only one year of hospital admissions.

Finally, nurse indicators were summarized at the ward level, and only 43 pairs of hospital-ward out of a total of 120 were available.

7. Conclusions

The findings of the RN4CAST@IT Study confirmed that a higher workload increases likelihood of inpatient mortality. Moreover, through this study we are the first to report that nurses' intention to leave exposes patients to a greater risk of mortality showing the need to generate retention interventions to contain nurse turnover as, if not managed, it contributes to increase nurse workload. National and local evidence-informed policies aimed at improving nurses' wages, work environment and wellbeing may represent the essential response of a country's government to improve job nurse satisfaction, quality of nursing care and the safety of hospitalized patients. Internationally healthcare systems should allocate more resources and support better work environments to enhance the quality and effectiveness of nursing care and improve nurses' wellbeing.

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Ethical considerations

This study was conducted according to the Helsinki Declaration and General Data Protection Regulations (EU 2016/679).

The study received ethical approval by the Liguria Region Ethics Committee (Reg. #028REG2015).

CRediT authorship contribution statement

Gianluca Catania: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Milko Zanini:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Marzia A. Cremona:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Paolo Landa:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Maria Emma Musio:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology. **Roger Watson:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Giuseppe Aleo:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Linda H. Aiken:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Loredana Sasso:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Annamaria Bagnasco:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing.

Declaration of competing interest

None.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.healthpol.2024.105032.

References

[1] Aiken LH, Sloane DM, Bruyneel L, Van den Heede K, Griffiths P, Busse R, Diomidous M, Kinnunen J, Kózka M, Lesaffre E, McHugh MD, Moreno-Casbas MT, Rafferty AM, Schwendimann R, Scott PA, Tishelman C, van Achterberg T, Sermeus W. RN4CAST consortium. Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. Lancet 2014;383(9931):1824–30. https://doi.org/10.1016/S0140-6736(13)62631-8.

[2] Aiken LH, Simonetti M, Sloane DM, Cerón C, Soto P, Bravo D, Galiano A, Behrman JR, Smith HL, McHugh MD, Lake ET. Hospital nurse staffing and patient outcomes in Chile: a multilevel cross-sectional study. Lancet Glob Health 2021;9(8):e1145–53. https://doi.org/10.1016/S2214-109X(21)00209-6.

[3] McHugh MD, Aiken LH, Sloane DM, Windsor C, Douglas C, Yates P. Effects of nurse-to-patient ratio legislation on nurse staffing and patient mortality, readmissions, and length of stay: a prospective study in a panel of hospitals. Lancet 2021;397(10288):1905–13. https://doi.org/10.1016/S0140-6736(21)00768-6.

[4] Krupp A, Lasater KB, McHugh MD. Intensive care unit utilization following major surgery and the nurse work environment. AACN Adv Crit Care 2021;32(4):381–90. https://doi.org/10.4037/aacnacc2021383.

[5] Kane RL, Shamliyan TA, Mueller C, Duval S, Wilt TJ. The association of registered nurse staffing levels and patient outcomes: systematic review and meta-analysis. Med Care 2007;45(12):1195–204.

[6] EN. Communication from the commission to the european parliament and the council on patient safety, including the prevention and control of healthcare-associated infections. 2008. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0836:FIN:EN:PDF (Accessed May 15th, 2023).

[7] Sloane DM, Smith HL, McHugh MD, Aiken LH. Effect of changes in hospital nursing resources on improvements in patient safety and quality of care: a panel study. Med Care 2018;56(12):1001–8.

[8] Needleman J, Buerhaus P, Pankratz VS, Leibson CL, Stevens SR, Harris M. Nurse staffing and inpatient hospital mortality. N Engl J Med 2011;364(11):1037–45.

[9] Audet LA, Bourgault P, Rochefort CM. Associations between nurse education and experience and the risk of mortality and adverse events in acute care hospitals: a systematic review of observational studies. Int J Nurs Stud 2018;80:128–46. https://doi.org/10.1016/j.ijnurstu.2018.01.007.

[10] Shin S, Park JH, Bae SH. Nurse staffing and nurse outcomes: a systematic review and meta-analysis. Nurs Outlook 2018;66(3):273–82. https://doi.org/10.1016/j.outlook.2017.12.002.

[11] Salyers MP, Bonfils KA, Luther L, Firmin RL, White DA, Adams EL, Rollins AL. The relationship between professional burnout and quality and safety in healthcare: a meta-analysis. J Gen Intern Med 2017;32(4):475–82. https://doi.org/10.1007/s11606-016-3886-9.

[12] Lake ET, Sanders J, Duan R, Riman KA, Schoenauer KM, Chen Y. A meta-analysis of the associations between the nurse work environment in hospitals and 4 sets of outcomes. Med Care 2019;57(5):353–61. https://doi.org/10.1097/MLR.0000000000001109.

[13] Aiken LH, Clarke SP, Sloane DM, Sochalski JA, Busse R, Clarke H, Giovannetti P, Hunt J, Rafferty AM, Shamian J. Nurses' reports on hospital care in five countries. Health Aff (Millwood) 2001;20(3):43–53. https://doi.org/10.1377/hlthaff.20.3.43.

[14] Sermeus W, Aiken LH, Van den Heede K, Rafferty AM, Griffiths P, Moreno-Casbas MT, Busse R, Lindqvist R, Scott AP, Bruyneel L, Brzostek T, Kinnunen J, Schubert M, Schoonhoven L, Zikos D. RN4CAST consortium. Nurse forecasting in Europe (RN4CAST): rationale, design and methodology. BMC Nurs 2011;10:6. https://doi.org/10.1186/1472-6955-10-6.

[15] Rocco G, Affonso DD, Mayberry LJ, Stievano A, Alvaro R, Sabatino L. The evolution of professional nursing culture in italy: metaphors and paradoxes. Glob Qual Nurs Res 2014 Oct 8;1. https://doi.org/10.1177/2333393614549372. 2333393614549372PMID: 28462290; PMCID: PMC5342861.

[16] Lake ET. Development of the practice environment scale of the nursing work index. Res Nurs Health 2002;25(3):176–88. https://doi.org/10.1002/nur.10032.
[17] R Core Team. R: a language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2017. https://www.R-project.org (Accessed May 15th, 2023).
[18] RStudio Team. RStudio: integrated development environment for r. Boston, MA: RStudio, Inc; 2016. http://www.rstudio.com (Accessed May 15th, 2023).
[19] McHugh MD, Rochman MF, Sloane DM, Berg RA, Mancini ME, Nadkarni VM, Merchant RM, Aiken LH. & American heart association's get with the guidelines-resuscitation investigators. Better nurse staffing and nurse work environments associated with increased survival of in-hospital cardiac arrest patients. Med Care 2016;54(1):74. https://doi.org/10.1097/MLR.0000000000000456.
[20] Bettencourt AP, McHugh MD, Sloane DM, Aiken LH. Nurse staffing, the clinical work environment, and burn patient mortality. J Burn Care Res 2020;41(4): 796–802. https://doi.org/10.1093/jbcr/iraa061.
[21] De Belvis AG, Meregaglia M, Morsella A, Adduci A, Perilli A, Cascini F, Solipaca A, Fattore G, Ricciardi W, Maresso A, Scarpetti G. Italy: health system review. Health Syst Transit 2022;24(4):97–104.
[22] Aiken LH, Sermeus W, Van den Heede K, Sloane DM, Busse R, McKee M, Bruyneel L, Rafferty AM, Griffiths P, Moreno-Casbas MT, Tishelman C, Scott A, Brzostek T, Kinnunen J, Schwendimann R, Heinen M, Zikos D, Sjetne IS, Smith HL. Kutney-Lee A. Patient safety, satisfaction, and quality of hospital care: cross sectional surveys of nurses and patients in 12 countries in Europe and the United States. BMJ 2012;344:e1717. https://doi.org/10.1136/bmj.e1717.
[23] Sasso L, Bagnasco A, Zanini M, Catania G, Aleo G, Santullo A, Spandonaro F, Icardi G, Watson R, Sermeus W. The general results of the RN4CAST survey in Italy. J Adv Nurs 2017;73(9):2028–30. https://doi.org/10.1111/jan.13066.
[24] OECD. Health at a glance 2019: oecd indicators. Paris: OECD Publishing; 2019. https://doi.org/10.1787/4dd50c09-en (Accessed May 15th, 2023).
[25] OECD. Health at a glance 2021: oecd indicators. Paris: OECD Publishing; 2021. https://doi.org/10.1787/ae3016b9-en (Accessed May 15th, 2023).
[26] Sasso L, Bagnasco A, Catania G, Zanini M, Aleo G, Watson R. RN4CAST@it working group. push and pull factors of nurses' intention to leave. J Nurs Manag 2019;27 (5):946–54. https://doi.org/10.1111/jonm.12745.
[27] Dyo M, Kalowes P, Devries J. Moral distress and intention to leave: a comparison of adult and paediatric nurses by hospital setting. Intensive Crit Care Nurs 2016;36: 42–8. https://doi.org/10.1016/j.iccn.2016.04.003. Epub 2016 May 19. PMID: 27209561.
[28] Galanis P, Vraka I, Fragkou D, Bilali A, Kaitelidou D. Nurses' burnout and associated risk factors during the COVID-19 pandemic: a systematic review and meta-analysis. J Adv Nurs 2021;77(8):3286–302. https://doi.org/10.1111/jan.14839.
[29] Catania G, Zanini M, Hayter M, Timmins F, Dasso N, Ottonello G, Aleo G, Sasso L, Bagnasco A. Lessons from Italian front-line nurses' experiences during the COVID-19 pandemic: a qualitative descriptive study. J Nurs Manag 2021;29(3):404–11. https://doi.org/10.1111/jonm.13194.
[30] World Health Organization. (2016). Global strategic directions for strengthening nursing and midwifery 2016–2020. Retrieved from https://www.who.int/hrh/nursing_midwifery/global-strategic-midwifery2016-2020.pdf?ua=1 (Accessed May 15th, 2023).
[31] Squires A., Sermeus W. (2015) ICN policy brief quantity, quality and relevance of the nursing workforce to patient outcomes. Retrieved from https://www.who.int/workforcealliance/knowledge/resources/ICN_PolBrief3QuantityQualityworkforcePatientOutcomes.pdf (Accessed May 15th, 2023).
[32] European Commission (2021) NextGenerationEU: european Commission endorses Italy's €191.5 billion recovery and resilience plan https://ec.europa.eu/commission/presscorner/detail/en/ip_21_3126 (Accessed May 15th, 2023).