Article

Factors Associated with In-Hospital Mortality in Acute Care Hospital Settings: A Prospective Observational Study

Ana María Porcel-Gálvez [1,2] , **Sergio Barrientos-Trigo [1,2,*]** , **Eugenia Gil-García [1,2]** ,
Olivia Aguilera-Castillo [3] , **Antonio Juan Pérez-Fernández [4]** and **Elena Fernández-García [1,2]**

[1]   Faculty of Nursing, Physiotherapy and Podiatry, Universidad de Sevilla, 41009 Seville, Spain;
      aporcel@us.es (A.M.P.-G.); egil@us.es (E.G.-G.); efernandez23@us.es (E.F.-G.)
[2]   Research Group under the Andalusian Research, Development and Innovation Scheme CTS-1019 Complex
      Care, Chronic and Health Outcomes, Universidad de Sevilla, 41009 Seville, Spain
[3]   Hospital San Agustín de Linares, Servicio Andaluz de Salud, 23700 Linares (Jaen), Spain;
      oliviaaguilera7@gmail.com
[4]   Hospital Santa Ana de Motril Hospital, Servicio Andaluz de Salud, 18600 Motril (Granada), Spain;
      ajpf76@gmail.com
*   Correspondence: sbarrientos@us.es; Tel.: +34-955420956

check for
updates

Abstract: *Background:* In-hospital mortality is a key indicator of the quality of care. Studies so far have demonstrated the influence of patient and hospital-related factors on in-hospital mortality. Currently, new variables, such as nursing workload or the level of dependency, are being incorporated. We aimed to identify which individual, clinical and hospital characteristics are related to hospital mortality. *Methods*: A multicentre prospective observational study design was used. Sampling was conducted between February 2015 and October 2017. Patients over 16 years, admitted to medical or surgical units at 11 public hospitals in Andalusia (Spain), with a foreseeable stay of at least 48 h were included. Multivariate regression analyses were performed to analyse the data. *Results*: The sample consisted of 3821 assessments conducted in 1004 patients. The mean profile was that of a male (52%), mean age of 64.5 years old, admitted to a medical unit (56.5%), with an informal caregiver (60%). In-hospital mortality was 4%. The INICIARE (Inventario del Nivel de Cuidados Mediante Indicadores de Clasificación de Resultados de Enfermería) scale yielded an adjusted odds ratio [AOR] of 0.987 (95% confidence interval [CI]: 0.97–0.99) and the nurse staffing level (NSL) yielded an AOR of 1.197 (95% CI: 1.02–1.4). *Conclusion*: Nursing care dependency measured by INICIARE and nurse staffing level was associated with in-hospital mortality.

Keywords: hospital mortality; nursing care dependency; nursing staffing level; observational study; multivariate analysis

1. Introduction

The International Classification for Patient Safety defined an adverse event (AE) as any healthcare-related incident that causes harm to patients [1]. The prevalence of in-hospital AEs in the European Union ranges from 8% to 12%, where 1 in every 100,000 inhabitants dies from this cause, i.e., about 5000 deaths per year [2,3]. The latest report by the Ibero-American Study of Adverse Events (IBEAS) established a prevalence of AEs of 10.5% and a cumulative incidence close to 20% [4]. AEs increase hospital stays by a mean of 8.7 days and double inpatient mortality (relative risk (RR) = 2.10) [5,6].

Int. J. Environ. Res. Public Health **2020**, *17*, 7951

2 of 10

In-hospital mortality is a key indicator of quality of care that is associated with high-level process indicators [7]. The prevalence of in-hospital mortality is around 5% [8,9]. In addition, there exists an estimated increase mortality of 10% due to unsafe care [10].

In addition, comorbidity also plays an important role, affecting up to 55% of in-hospital deaths [11]. Examples include frailty (adjusted hazard risk (HR) = 4.97) [12], dementia (13.3%) [13] and adverse events such as inpatient fall (18.8%) [14], or inpatient hip fracture (HR = 2.12) in hospitals [15].

Numerous studies propose different explanatory models of hospital mortality [16–19]. These studies show that in-hospital mortality is influenced by numerous different factors and should be assessed with due consideration of a wide range of potential confounds including patient's factors (individual and clinical) and hospital-related factors [20].

Age and sex are identified as important factors when considering models of in-hospital mortality. For example, for each year of age, the probability of dying increases by 3% [21]. In fact, the level of dependency is one of the individual factors most frequently associated with negative health outcomes in hospitalised patients [22]. So far, studies have shown the relationship between the level of dependency and mortality, measured either using the Barthel index [23] or the number of nursing diagnoses [24].

However, nursing care dependency may be defined as the care needs that patients have during their hospital stay. In turn, patient care needs result in nursing tasks that increase the workload of nurses. In this context, our research group has developed and validated the INICIARE (Inventario del Nivel de Cuidados mediante Indicadores de Clasificación de Resultados de Enfermería) scale to measure the level of nursing care dependency in hospitalised patients. As a result, INICIARE may also be considered to be a scale for measuring nursing workload, pioneering an approach based on outcomes rather than on interventions or activities [25–27].

Finally, among the hospital-related factors, nurse staffing stands out, as numerous studies show that a good nurse staffing may reduce hospital mortality by 12–14% [28–30]. Among the clinical factors, an increase in the number of days since admission stands out, as for each additional day since admission the probability of dying increases by 3% [31]. Therefore, the aim of this study was to identify which patient (individual and clinical) and hospital- factors are related to hospital mortality.

2. Materials and Methods

2.1. Study Design

This was a multicentre prospective observational cohort study.

2.2. Participants and Sampling

The present study was conducted between February 2015 and October 2017 in the Andalusian Health Care System (southern Spain), which comprises 26 public hospitals providing health coverage to 8 million citizens. Hospitals were classified in three hospital categories according to their level of specialisation and reference population: primary (>500 beds and large metropolitan areas), specialist (between 200 and 500 beds and small metropolitan areas), and tertiary hospitals (<200 beds and rural areas) [32]. These hospitals represent the specialised healthcare centres of 3.5 million citizens.

The necessary sample size was calculated based on the prevalence of in-hospital mortality, which was 4.4% according to a report by the Spanish National Study on Hospitalisation-Related Adverse Events [33]. By establishing a 99% confidence level and 2% accuracy, the sample amounted to 696 subjects. Stratified consecutive sampling was performed based on (1) hospital size (number of beds), (2) unit (medical or surgical), and (3) sex and age group. A randomisation criterion based on the patient identification number in the electronic health record was included. The following inclusion criteria were used: (1) patients over 16 years of age, (2) admitted to a medical or surgical unit, (3) with a foreseeable stay of more than 48 h.

2.3. Data Collection

The inpatients were assessed with the survey by the Registered Nurses (RNs) during their shift. Patients were assessed on the day of their admission and every 48 h subsequently during their hospital stay until discharge or death. The nurses coordinated weekly to review how data were being collected from each of the patients in their units.

The number of participating nurses varied according to the size of the hospital and the number of participating units, from 3–4 nurses in small hospitals to 30–35 in large hospitals. In each hospital, there were two nurses coordinated with the team at their hospital. A training workshop was held for all hospital participants to ensure the proper use of data collection methods and instruments. The RNs participating in the project attended these workshops. In total, 157 registered nurses participated voluntarily and were team members of the funded research project.

The nurse's coordinator recorded the data collected by the nurses on the encrypted web platform Limesurvey to ensure the correct processing of the data. This process was assessed on a monthly basis during the data collection periods.

2.4. Study Variables

The outcome variable studied was the crude mortality rate as an adverse event. The crude mortality rate for a hospital considers the number of patient deaths that occur in a given year in a hospital and then compares it with the number of people admitted for care to that hospital during an equal period.

The independent variables have been grouped into patient (individual and clinical) and hospital factors:

Individual factors: Gender (male, female), age and level of education (no education, minimally literate, secondary education, university education).

Clinical factors: Length of stay, season (winter, spring, summer, autumn), and other clinical variables, such as cognitive status measured by Pfeiffer's test, risk of developing pressure ulcers as measured by the INTEGRARE scale (at risk of pressure ulcers, not at risk of pressure ulcers), and level of nursing care dependency as measured by the INICIARE scale, which are detailed below:

Pfeiffer's test is widely used to assess cognitive status. It consists of 10 items and has two cut-off points. Cognitive impairment is suspected when the error score is equal to 3 or more in people who can read and write, or to 4 or more in people who cannot [34].

The INTEGRARE scale was used to assess pressure ulcer (PU) risk in inpatients. It is a recently created scale with excellent psychometric properties (internal consistency total Cronbach's $\alpha = 0.86$). It consists of 6 items measured on a five-point Likert scale (5 reflects the most desirable patient's condition, and 1 reflects the least desirable). The scoring range is 6–30. Confirmatory factor analysis demonstrated the unidimensionality of the scale, indicating a good model fit (minimum discrepancy per degree of freedom (CMIN/DF) = 4; goodness-of-fit index (GFI), comparative fit index (CFI), normed fit index (NFI), incremental fit index (IFI) = 0.999; root mean squared error approximation (RMSEA) = 0.028) [35].

The INICIARE scale was used to assess nursing care dependency in inpatients [21]. INICIARE is a recently created scale with excellent psychometric properties (intraclass correlation coefficient = 0.830–0.964; overall internal consistency as measured by Cronbach's $\alpha = 0.98$, internal consistency of individual subscales as measured by Cronbach's α ranging between $\alpha = 0.92$–0.98). It consists of 55 items measured on a five-point Likert scale (5 reflects the most desirable condition of the patient, and 1 reflects the least desirable). The scoring range is 55–275, with three cut-off points (four intervals) that indicate levels of dependency. The seven factors identified using exploratory factor analysis explained 76.8% of the overall variance [36].

All of these scales were administered by registered nurses during their shift.

Hospital-related factors: admission hospital (primary care hospitals, specialty hospitals, and tertiary-care hospitals), type of admission unit (medical, surgical) and nurse staffing level (NSL).

The nurse staffing level is an indicator that represents the available nursing workforce in a hospital. These data were self-reported by the nurses. The nurses' coordinator reported the number of patients who were admitted to the unit, and the total number of nurses who were scheduled on each shift. Each admission time was recorded considering the patient details and unit. The NSL was calculated as the division of the total number of patients, by the number of experienced nurses that were available on each shift per unit, at each participating hospital [23,37].

2.5. Data Analyses

The chi-square statistic was used to test for association between pairs of categorical and ordinal variables. For quantitative variables, non-parametric tests were used (the Mann–Whitney U test and the Kruskall–Wallis test).

A multivariate logistic regression model was conducted in which in-hospital mortality was established as the dependent variable and INICIARE and other related variables (sex, age, length of stay, unit, type of hospital, season, and NSL) were established as independent variables. The calibration and the discrimination of the model were checked using the Hosmer–Lemeshow test and a receiver operating characteristic (ROC) curve, respectively. The data were analysed using the SPSS v. 23 statistical package (SPSS/IBM, Chicago, IL, USA) and R Commander.

2.6. Ethical Considerations

This project has been approved by the ethics committee of the Andalusian Healthcare System (Approved 22 March 2013; Code: CPMP/ICH/135/95). Patients were informed verbally and in writing about the objective and purpose of the study. Patients signed an informed consent form and were aware of their right to withdraw from the study at any time. The anonymity of the patients was preserved at all times by using participant numbers. The participating nurses whom collected the data signed a confidentiality agreement consent and were aware of their right to withdraw from the study at any time.

3. Results

3.1. Sample Characteristics

The sample consisted of 3821 assessments conducted in 1004 patients. The number of assessments ranged from 2 to 28, with a mean value of 3.78 (SD = 2.37). Most of the patients were admitted to medical units (56.3%). The mean profile was that of a male (52%), with a mean age of 64.5 years old, with a caregiver (60%). In-hospital mortality was 4%. Complete patient characteristics can be found in Table 1.

Table 1. Sample characteristics.

	All Patients (*n* = 1004)	Dead Patients (*n* = 40)	Living Patients (*n* = 964)	Dead Patients vs. Living Patients
Individual's factors				
Sex				
Female	480 (47.8)	18 (45)	462 (47.8)	0.717
Male	524 (52.2)	22 (55)	502 (52.2)	
Age				0.001
Mean (SD)	64.5 (17.1)	73.3 (12.7)	64.2 (17.2)	
Level of education				
No education	229 (22.7)	13 (32.5)	216 (22.5)	
Minimally literate	518 (51.6)	26 (65)	492 (51)	0.008
Secondary education	195 (19.4)	1 (2.5)	194 (20)	
University education	62 (6.2)	0	62 (6.5)	

Table 1. *Cont.*

	All Patients (*n* = 1004)	Dead Patients (*n* = 40)	Living Patients (*n* = 964)	Dead Patients vs. Living Patients
Clinical factors				
Length of stay				
Mean (SD)	10.7 (10.7)	16 (21.7)	10.5 (10)	0.074
Pfeiffer's test				
Oriented	866 (86.3)	28 (70)	838 (87)	0.002
Other	138 (13.7)	12 (30)	126 (13)	
INTEGRARE				
At risk of pressure ulcers	486 (48)	26 (65)	460 (48)	0.035
Not at risk of pressure ulcers	518 (52)	14 (35)	504 (52)	
INICIARE mean during stay				
Mean (SD)	217.5 (43.1)	174.2 (56.6)	219.3 (41.5)	<0.001
Season				
Winter	383 (38)	22 (55)	361 (37.4)	
Spring	448 (44.8)	10 (25)	445 (45.6)	0.004
Summer	101 (10)	2 (5)	99 (10.4)	
Autumn	62 (6.2)	6 (15)	56 (6)	
Hospital factors				
Admission hospital				
Regional	664 (66)	23 (57.5)	641 (66.5)	
Medical specialties	165 (16.4)	10 (25)	155 (16)	0.312
District	175 (17.4)	7 (17.5)	168 (17.5)	
Unit				
Medical	565 (56.3)	30 (75)	535 (55.5)	0.015
Surgical	439 (43.7)	10 (25)	429 (44.5)	
Nurse staffing level				
Mean (SD)	10.26 (2.74)	10.35 (2.24)	10.26 (2.78)	0.901

3.2. Relationships between Individual, Clinical, Hospital Characteristcs and Hospital Mortality

Table 2 shows the factors related to mortality. Only nursing care dependency, as measured by INICIARE, and NSL were significant variables in the model, with AORs of 0.987 and 1.197, respectively. Other associated factors were being older, being male, staying longer in hospital, being admitted to a medical unit, being admitted to a secondary-care hospital, and being admitted in winter. The model obtained a good adjustment with optimal calibration (Hosmer–Lemeshow: $p = 0.786$) and discrimination (area under curve [AUC] = 0.83 [0.75, 0.90]).

Table 2. Multivariate logistic regression model.

	B	95% CI	*p*	VIF
(Intercept)	0.388		0.528	
Sex [Male]	Reference			
Sex [Female]	0.811	0.409; 1.611	0.55	1.097154
Age	1.014	0.988; 1.04	0.299	1.323345
Length of stay	1.013	0.98; 1.03	0.275	1.090534
INICIARE centred mean: 217	0.983	0.976; 0.991	<0.001 *	1.302930
Season [Winter]	Reference			
Season [Spring]	0.265	0.116; 0.606	0.002 *	1.101491
Season [Summer]	0.223	0.043; 1.146	0.072	
Season [Autumn]	0.497	0.092; 2.05	0.369	
Hospital [Regional]	Reference			
Hospital [Specialty]	1.338	0.528; 3.389	0.539	1.143941
Hospital [District]	0.829	0.327; 2.099	0.692	
Unit [Medical]	Reference			
Unit [Surgical]	0.526	0.238; 1.162	0.112	1.142948
Nurse Staffing Level	1.197	1.02; 1.4	0.0215*	1.120576

* $p < 0.05$. Model calibration (Hosmer–Lemeshow test): p value = 0.7861. Model discrimination (receiver operating characteristic (ROC) curve): area under curve (AUC) = 0.83 (95% confidence interval (CI) [0.75; 0.90]. CI: Confidence Intervals; VIF: Variance Inflation Factor.

4. Discussion

The aim of this study was to identify which patient (individual and clinical) and hospital-characteristics are related to hospital mortality. This is the first study so far to include nursing care dependency of inpatients measured with a validated tool. Each point that the mean of the scale increases corresponds to odds of 0.98 of in-hospital mortality (i.e., the chance of in-hospital mortality decreases by 2%).

Age is one of the main determinants of patient mortality from injuries [38]. Our data indicate that, for each year of life, the probability of dying increases by 1.4%. Patients who died were on average 9 years older than those who lived. The mean age of the deceased (73 years) is similar to that reported in other studies [39]. The ageing of the population is increasing the mean age of hospitalized patients, leading to an increase in mortality and other adverse events, such as medication errors or infections [40,41]. This effect may be greater in medical units, as the mean age is higher in these units than in surgical units [38].

Another variable that influences mortality is the unit of admission, as patients in surgical units are 47.4% less likely to die than patients admitted to medical units. Other studies also showed higher mortality rates in medical units (31.6%) compared to surgical units (10.3%) [42], although surgical units have a higher probability of preventable deaths than medical units (30.8% vs. 13.3) [40].

In relation to seasonality, winter is the season with the highest in-hospital mortality rates. Some studies indicate that winter increases the number of admissions and readmissions of patients with serious diseases, such as heart failure (17.7%), myocardial infarction (6.3%), or pneumonia (51.3%) [43,44], resulting in increased mortality rates of admitted patients compared to other seasons (31.3%) [45,46]. For instance, in the United States, more than 1.5 million adults are admitted for community-acquired pneumonia (CAP) in winter, with 1 in 3 dying during their hospital stay [47].

Finally, among the organisational factors, NSL is directly related to in-hospital mortality. The mean NSL in our study was 10.3, which meant that for each additional patient, in-hospital mortality increased by 19%. A meta-analysis placed this percentage at 14% on average [11] based on studies with values ranging from 5% [48] to 31% [49]. The RN4CAST study found that the mean nurse staffing in European hospitals was 8.3, with Spain being the country with the highest level of nurse staffing (12.7) [21,28]. Our study is consistent with these data and provides evidence of the joint influence of NSL and nursing care dependency on the occurrence of in-hospital mortality. Future studies should incorporate this measure into the adjustment of the nurse staffing level to decrease in-hospital mortality.

Some limitations can be highlighted in this study. Not all relevant variables that have been demonstrated to affect patient mortality have been included here. For example, the literature has shown that patients with a higher probability of dying have a higher number of comorbidities [11,12], frailty [13], and dementia [14]. In our study we have included the evaluation of the cognitive state [34], which also affects mortality; nonetheless, it was not an explanatory variable in our model. Although hospital adverse events have also been shown to have a relationship with hospital mortality [33,39], all of them were not included. Our study has included a measure of the risk of ulcer pressure, a hospital adverse event. Future studies could include these variables to adjust for NSL and the effect of dependency on nursing care on hospital mortality.

5. Conclusions

Several factors related to hospital mortality have been investigated in the current study: (1) individual factors such as sex and age; (2) clinical factors such as length of stay, season, and nursing care dependency (measured by INICIARE9) and (3) hospital factors such as admission hospital, unit and NSL.

Nursing care dependency measured by INICIARE and NSL was the only significantly associated factor with in-hospital mortality. Including this scale in the assessment of patients both upon admission and during their hospital stay would improve models of in-hospital mortality and allow the level of patient care in hospitals to be measured and quantified.

Int. J. Environ. Res. Public Health **2020**, *17*, 7951

7 of 10

The finding in this study have important research applications. On one hand, it would enable the setting up of more complex and precise models that explain hospital mortality. On the other hand, it also shows how the nursing care influences hospital mortality: both in terms of the number of nurses (NSL) and the amount of nursing care provided (INICIARE).

In conclusion, the most important implications for health care policy-makers should be aimed at controlling the hospital factors that influence hospital mortality. The results of this study show that factors such as the type of hospital and the type of unit determine the death of the patient. Future studies should involve an in-depth analysis of patient care in these settings. Among the hospital factors, NSL stands out, showing a statistically significant relationship with hospital mortality. Health care policy-makers should study the status of their NSL at different levels (hospital and unit) in order to improve the provision of nursing staff and to provide safe and quality care.

References

1. Rafter, N.; Hickey, A.; Condell, S.; Conroy, R.; O'Connor, P.; Vaughan, D.; Williams, D. Adverse events in healthcare: Learning from mistakes. *QJM* **2015**, *108*, 273–277. [CrossRef] [PubMed]

2. Ministry of Health Social Services and Equality. *Patient Safety Strategy for the National Health System 2015–2020 Period*; Ministry of Health Social Services and Equality: Madrid, Spain, 2015.

3. World Health Organization. WHO/Europe|Patient Safety—Data and Statistics. 2020. Available online: http://www.euro.who.int/en/health-topics/Health-systems/patient-safety/data-and-statistics (accessed on 6 February 2020).

4. Aranaz-Andrés, J.M.; Limón-Ramírez, R.; Aibar-Remón, C.; Gea-Velázquez De Castro, M.T.; Bolúmar, F.; Hernández-Aguado, I.; López-Fresneña, N.; Díaz-Agero-Pérez, C.; Tero- García, E.; Michel, P.; et al. Comparison of two methods to estimate adverse events in the IBEAS Study (Ibero-American study of adverse events): Cross-sectional versus retrospective cohort design. *BMJ Open* **2017**, *7*, e016546. [CrossRef] [PubMed]

5. Ahmed, A.H.; Thongprayoon, C.; Schenck, L.A.; Malinchoc, M.; Konvalinová, A.; Keegan, M.T.; Gajic, O.; Pickering, B.W. Adverse in-hospital events are associated with increased in-hospital mortality and length of stay in patients with or at risk of acute respiratory distress syndrome. *Mayo Clin. Proc.* **2015**, *90*, 321–328. [CrossRef] [PubMed]

6. Haukland, E.C.; Mevik, K.; von Plessen, C.; Nieder, C.; Vonen, B. Contribution of adverse events to death of hospitalised patients. *BMJ Open Qual.* **2019**, *8*, e000377. [CrossRef] [PubMed]

7. Ngantcha, M.; Le-Pogam, M.A.; Calmus, S.; Grenier, C.; Evrard, I.; Lamarche-Vadel, A.; Rey, G. Hospital quality measures: Are process indicators associated with hospital standardized mortality ratios in French acute care hospitals? *BMC Health Serv. Res.* **2017**, *17*, 578. [CrossRef]

8. Bai, A.D.; Srivastava, S.; Tomlinson, G.A.; Smith, C.A.; Bell, C.M.; Gill, S.S. Mortality of hospitalised internal medicine patients bedspaced to non-internal medicine inpatient units: Retrospective cohort study. *BMJ Qual. Saf.* **2018**, *27*, 11–20. [CrossRef] [PubMed]

9. Singal, A.K.; Salameh, H.; Kamath, P.S. Prevalence and in-hospital mortality trends of infections among patients with cirrhosis: A nationwide study of hospitalised patients in the United States. *Aliment. Pharmacol. Ther.* **2014**, *40*, 105–112. [CrossRef] [PubMed]

10. McCormick, B.; Pearson, M.; White, J. Hospital mortality rates and place of death. *J. Public Health* **2015**, *38*, 800–805. [CrossRef]

11. Luo, L.; Du, W.; Chong, S.; Ji, H.; Glasgow, N. Patterns of comorbidities in hospitalised cancer survivors for palliative care and associated in-hospital mortality risk: A latent class analysis of a statewide all-inclusive inpatient data. *Palliat Med.* **2019**, *33*, 1272–1281. [CrossRef]

12. Wen, Y.C.; Chen, L.K.; Hsiao, F.Y. Predicting mortality and hospitalization of older adults by the multimorbidity frailty index. *PLoS ONE* **2017**, *12*, e0187825. [CrossRef]

13. Martín, J.; Padierna, A.; Anton-Ladislao, A.; Moro, I.; Quintana, J.M. Predictors of mortality during hospitalization and 3 months after discharge in elderly people with and without dementia. *Aging Ment. Health* **2019**, *23*, 1057–1065. [CrossRef] [PubMed]

14. Singh, I.; Edwards, C.; Anwar, A. One-year mortality rates before and after implementing quality-improvement initiatives to prevent inpatient falls (2012–2016). *Geriatrics* **2018**, *3*, 9. [CrossRef] [PubMed]

15. Singh, I.; Hooton, K.; Edwards, C.; Lewis, B.; Anwar, A.; Johansen, A. Inpatient hip fractures: Understanding and addressing the risk of this common injury. *Age Ageing* **2020**, *49*, 481–486. [CrossRef] [PubMed]

16. Sanson, G.; Welton, J.; Vellone, E.; Cocchieri, A.; Maurici, M.; Zega, M.; Alvaro, R.; D'Agostino, F. Enhancing the performance of predictive models for Hospital mortality by adding nursing data. *Int. J. Med. Inform.* **2019**, *125*, 79–85. [CrossRef]

17. Kim, Y.; Kim, S.Y. Influence of Hospital Nurse Staffing Levels on the Colorectal Cancer Evaluation Grades, Mortality, and Length of Stay. *Korean J. Adult Nurs.* **2019**, *27*, 479–486. [CrossRef]

18. Needleman, J.; Liu, J.; Shang, J.; Larson, E.L.; Stone, P.W. Association of registered nurse and nursing support staffing with inpatient hospital mortality. *BMJ Qual. Saf.* **2020**, *29*, 10–18. [CrossRef]

19. Wen, M.; Han, Y.; Ye, J.; Cai, G.; Zeng, W.; Liu, X.; Huang, L.; Lian, Z.; Zeng, H. Peri-operative risk factors for in-hospital mortality in acute type A aortic dissection. *J. Thorac. Dis.* **2019**, *11*, 3887. [CrossRef]

20. Chung, W.; Sohn, M. The impact of nurse staffing on in-hospital mortality of stroke patients in Korea. *J. Cardiovasc. Nurs.* **2018**, *33*, 47–54. [CrossRef]

21. Schwartz, N.; Sakhnini, A.; Bisharat, N. Predictive modeling of inpatient mortality in departments of internal medicine. *Intern. Emerg. Med.* **2018**, *13*, 205–211. [CrossRef]

22. Benraad, C.E.M.; Disselhorst, L.; Laurenssen, N.C.W.; Hilderink, P.H.; Melis, R.J.F.; Spijker, J.; Olde Rikkert, M.G.M. Frailty, multimorbidity and functional status as predictors for health outcomes of acute psychiatric hospitalisation in older adults. *Aging Ment. Health* **2018**, *24*, 119–128. [CrossRef]

23. Bahrmann, A.; Benner, L.; Christ, M.; Bertsch, T.; Sieber, C.C.; Katus, H.; Bahrmann, P. The Charlson Comorbidity and Barthel Index predict length of hospital stay, mortality, cardiovascular mortality and rehospitalization in unselected older patients admitted to the emergency department. *Aging Clin. Exp. Res.* **2019**, *31*, 1233–1242. [CrossRef]

24. D'Agostino, F.; Sanson, G.; Cocchieri, A.; Vellone, E.; Welton, J.; Maurici, M.; Alvaro, R.; Zega, M. Prevalence of nursing diagnoses as a measure of nursing complexity in a hospital setting. *J. Adv. Nurs.* **2017**, *73*, 2129–2142. [CrossRef]

25. Barrientos-Trigo, S.; Gil-García, E.; Romero-Sánchez, J.M.; Badanta-Romero, B.; Porcel-Gálvez, A.M. Evaluation of psychometric properties of instruments measuring nursing-sensitive outcomes: A systematic review. *Int. Nurs. Rev.* **2019**, *66*, 209–223. [CrossRef]

26. Griffiths, P.; Saville, C.; Ball, J.; Jones, J.; Pattison, N.; Monks, T. Nursing workload, nurse staffing methodologies and tools: A systematic scoping review and discussion. *Int. J. Nurs.* **2020**, *103*, 103487. [CrossRef] [PubMed]

27. Morales-Asencio, J.M.; Porcel-Gálvez, A.M.; Oliveros-Valenzuela, R.; Rodríguez-Gómez, S.; Sánchez-Extremera, L.; Serrano-López, F.A.; Aranda-Gallardo, M.; Canca-Sánchez, J.C.; Barrientos-Trigo, S. Design and validation of the INICIARE instrument, for the assessment of dependency level in acutely ill hospitalised patients. *J. Clin. Nurs.* **2015**, *24*, 761–777. [CrossRef]

28. Aiken, L.H.; Sloane, D.; Griffiths, P.; Rafferty, A.M.; Bruyneel, L.; McHugh, M.; Maier, C.B.; Moreno-Casbas, T.; Ball, J.E.; Ausserhofer, D.; et al. RN4CAST Consortium. Nursing skill mix in European hospitals: Cross-sectional study of the association with mortality, patient ratings, and quality of care. *BMJ Qual. Saf.* **2017**, *26*, 559–568. [CrossRef] [PubMed]

29. Cho, E.; Sloane, D.M.; Kim, E.-Y.; Kim, S.; Choi, M.; Yoo, I.Y.; Lee, H.S.; Aiken, L.H. Effects of nurse staffing, work environments, and education on patient mortality: An observational study. *Int. J. Nurs.* **2015**, *52*, 535–542. [CrossRef] [PubMed]

30. Driscoll, A.; Grant, M.J.; Carroll, D.; Dalton, S.; Deaton, C.; Jones, I.; Lehwaldt, D.; McKee, G.; Munyombwe, T.; Astin, F. The effect of nurse-to-patient ratios on nurse-sensitive patient outcomes in acute specialist units: A systematic review and meta-analysis. *Eur. J. Cardiovasc. Nurs.* **2018**, *17*, 6–22. [CrossRef]

31. López-Mestanza, C.; Andaluz-Ojeda, D.; Gómez-López, J.R.; Bermejo-Martín, J.F. Clinical factors influencing mortality risk in hospital-acquired sepsis. *J. Hosp. Infect.* **2018**, *98*, 194–201. [CrossRef]

32. Consejeria de Salud, A. Conjunto Mínimo Básico de Datos al Alta Hospitalaria. 2014. Available online: http://www.sspa.juntadeandalucia.es/servicioandaluzdesalud/contenidos/publicaciones/datos/597/pdf/conjuntominimobasicodatosaltahospitalariagruposrelacionadosdiagnosticoandalucia2013.pdf (accessed on 6 February 2020).

33. Aranaz Andrés, J.M.; Aibar-Remón, C.; Vitaller Burillo, J.; Ruiz López, P. National Study on Hospitalisation-Related Adverse Events. *ENEAS 2005*. Available online: https://www.seguridaddelpaciente.es/resources/contenidos/english2/2006/ENEAS_ENG.pdf (accessed on 6 February 2020).

34. Martínez de la Iglesia, J.; Herrero, R.D.; Vilches, M.C.O.; Taberné, C.A.; Colomer, C.A.; Luque, R.L. Adaptación y validación al castellano del cuestionario de Pfeiffer (SPMSQ) para detectar la existencia de deterioro cognitivo en personas mayores de 65 años. *Med. Clin.* **2001**, *117*, 129–134. [CrossRef]

35. Porcel-Gálvez, A.M.; Romero-Castillo, R.; Fernández-García, E.; Barrientos-Trigo, S. Psychometric Testing INTEGRARE, an Instrument for the Assesment of Pressure Ulcer Risk in Inpatients. *Int. J. Nurs. Knowl.* **2017**, *29*, 165–170. [CrossRef]

36. Barrientos Trigo, S. *Validez Externa y Convergencia de la Escala INICIARE 2.0 y Care Dependency Scale: Estudio Multicéntrico/Doctorando: Sergio Barrientos Trigo; Directoras: Ana Mo Porcel Gálvez y Eugenia Gil García*; Universidad de Sevilla, Dpto. Enfermería: Seville, Spain, 2015.

37. Lang, T.A.; Hodge, M.; Olson, V.; Romano, P.S.; Kravitz, R.L. Nurse-patient ratios: A systematic review on the effects of nurse staffing on patient, nurse employee, and hospital outcomes. *J. Nurs. Adm.* **2004**, *34*, 326–337. [CrossRef]

38. Bäckström, D.; Larsen, R.; Steinvall, I.; Fredrikson, M.; Gedeborg, R.; Sjöberg, F. Deaths caused by injury among people of working age (18–64) are decreasing, while those among older people (64+) are increasing. *Eur. J. Trauma Emerg. Surg.* **2018**, *44*, 589–596. [CrossRef] [PubMed]

39. Flaatten, H.; Brattebø, G.; Alme, B.; Berge, K.; Rosland, J.H.; Viste, A.; Bertelsen, B.; Harthug, S.; Aardal, S. Adverse events and in-hospital mortality: An analysis of all deaths in a Norwegian health trust during 2011. *BMC Health Serv. Res.* **2017**, *17*, 465. [CrossRef] [PubMed]

40. Hogan, H.; Healey, F.; Neale, G.; Thomson, R.; Vincent, C.; Black, N. Preventable deaths due to problems in care in English acute hospitals: A retrospective case record review study. *BMJ Qual. Saf.* **2012**, *21*, 737–745. [CrossRef] [PubMed]

41. Vadla, D.; Božikov, J.; Åkerström, B.; Cheung, W.-Y.; Kovačić, L.; Masanovic, M.; Merilainen, S.; Mihel, S.; Nummelin-Niemi, H.; Stefanaki, I.; et al. Differences in healthcare service utilisation in elderly, registered in eight districts of five European countries. *Scand. J. Public Health* **2011**, *39*, 272–279. [CrossRef] [PubMed]

42. Ferrando-Vivas, P.; Jones, A.; Rowan, K.M.; Harrison, D.A. Development and validation of the new ICNARC model for prediction of acute hospital mortality in adult critical care. *J. Crit. Care* **2017**, *38*, 335–339. [CrossRef] [PubMed]

43. Butala, N.M.; Secemsky, E.A.; Wasfy, J.H.; Kennedy, K.F.; Yeh, R.W. Seasonality and Readmission after Heart Failure, Myocardial Infarction, and Pneumonia. *Health Serv. Res.* **2018**, *53*, 2185–2202. [CrossRef] [PubMed]

44. Rodrigues, P.C.; Pinheiro, S.; Junger, W.; Ignotti, E.; Hacon, S. Climatic variability and morbidity and mortality associated with particulate matter. *Rev. Saude Publ.* **2017**, *51*, 91. [CrossRef]

45. Hodzic, E.; Perla, S.; Iglica, A.; Vucijak, M. Seasonal Incidence of Acute Coronary Syndrome and Its Features. *Mat. Sociomed.* **2018**, *30*, 10. [CrossRef]

46. Khan, R.C.; Halder, D. Effect of seasonal variation on hospital admission due to cardiovascular disease—Findings from an observational study in a divisional hospital in Bangladesh. *BMC Cardiovasc. Disor.* **2014**, *14*, 76. [CrossRef] [PubMed]

47. Ramirez, J.A.; Wiemken, T.L.; Peyrani, P.; Arnold, F.W.; Kelley, R.; Mattingly, W.A.; Nakamatsu, R.; Pena, S.; Guinn, B.E.; Furmanek, S.P.; et al. Adults Hospitalized with Pneumonia in the United States: Incidence, Epidemiology, and Mortality. *Clin. Infect. Diss.* **2017**, *65*, 1806–1812. [CrossRef] [PubMed]

48. McHugh, M.D.; Rochman, M.F.; Sloane, D.M.; Berg, R.A.; Mancini, M.E.; Nadkarni, V.M.; Merchant, R.M.; Aiken, L.H. Better Nurse Staffing and Nurse Work Environments Associated with Increased Survival of In-Hospital Cardiac Arrest Patients. *Med. Care* **2016**, *54*, 74–80. [CrossRef] [PubMed]

49. Sakr, Y.; Moreira, C.L.; Rhodes, A.; Ferguson, N.D.; Kleinpell, R.; Pickkers, P.; Kuiper, M.A.; Lipman, J.; Vincent, J.L. The impact of hospital and ICU organizational factors on outcome in critically ill patients: Results from the Extended Prevalence of Infection in Intensive Care Study. *Crit. Care Med.* **2015**, *43*, 519–526. [CrossRef] [PubMed]