Submitted: 04 December, 2023 Accepted: 29 January, 2024 Published: 08 July, 2024 DOI:10.22514/sv.2024.083

Open Access
Signa Vitae

ORIGINAL RESEARCH

Clinical factors of patients who die in an emergency department: the significance of early clinical data, especially for the elderly

Marina Serra[1], Oriol Yuguero[1,2,*]

[1]Faculty of Medicine, University of Lleida, 25198 Lleida, Spain
[2]ERLab, Research on Emergency Medicine, IRBLLEIDA, 25198 Lleida, Spain

***Correspondence**
Oriol.yuguero@udl.cat
(Oriol Yuguero)

Abstract

Numerous studies show that vital signs can act as predictors of death. We test these hypotheses with data from the summer of 2022, when Spanish emergency departments (EDs) were overwhelmed. The main objective of this study is to describe the clinical factors of patients who died in the emergency department. This study is a retrospective descriptive analysis of patients who attended an ED between January 2021 and September 2022, focusing on those who died during the same episode. Clinical, sociodemographic and management variables were evaluated. A comparison between the study years was performed. A bivariate analysis was conducted to examine the relationship between the cause of death, triage level, and survival. During the study period, 116,870 patients attended the ED, 317 (0.27%) of whom died during the same ED episode. Of the patients who died, 54.3% were men and 45.7% were women. 182 people died in 2021 and 135 in 2022. The primary cause of death is respiratory. The profile of a patient who dies in the emergency department is an elderly male (>80 years old) coming from their home with a triage level indicating a risk to life (urgent or emergent), presenting cardiovascular risk factors, and dying from a respiratory cause. Factors such as hypotension, tachypnea, hypoxia, elevated creatinine, and lactate levels, observed during the first minutes in the emergency department, significantly determine patient survival ($p < 0.05$). It can be asserted that clinical parameters can estimate patients' immediate vital prognosis in the first hours of attending the emergency department, especially among elderly patients and those with a severe triage level (emergent/urgent). Creating a score for elderly patients with certain clinical parameters upon triage could help to provide better healthcare and reduce the delay in attending to them.

Keywords

Mortality; Clinical signs; Emergency; Health management; Health systems

1. Introduction

The purpose of the hospital emergency department is to respond to the needs of the population quickly, safely, and with quality [1]. It is a multidisciplinary service operating 24 hours a day, every day of the year, providing services until the clinical condition stabilizes [2].

Numerous studies have demonstrated that vital signs are reliable predictors of mortality [3, 4], highlighting the importance of determining vital signs [5] and other parameters to predict the onset of shock or other life-threatening situations. The waiting time for triage has also been correlated with lethality [6, 7], according to the Spanish triage system based on the Andorran model [8]. Factors such as triage level [9], previous visits to the department [10], analytical parameters such as serum lactate [11], length of stay in the department [12], bed availability, and delay in initiating treatment [13] also influence survival.

During the summer of 2022, the emergency departments in Spain were overwhelmed. Whether due to a massive influx of patients, a lack of follow-up for certain conditions during the Severe acute respiratory syndrome-coronavirus 2 (SARS-COV2) pandemic, or a shortage of healthcare personnel, the objective of providing quality and urgent care was not met under the best conditions. This study aims to describe the profile of patients who die in our emergency departments, with a special mention of the summer of 2022, and to evaluate the factors that play a more prominent and common role in such patients. It also seeks to determine whether the increased patient death rates were due to the severe heat of the summer of 2022, or were similar to the preceding months or to summer 2021.

The main objective of this study is to describe the common clinical factors of patients who died in the emergency depart-

ment.

2. Materials and methods

2.1 Study design

A retrospective study of all patients who died in the emergency department between January 2021 and September 2022. The years 2021 and 2022 were chosen for the study, as 2020 data, heavily influenced by the SARS-COV2 pandemic, were deemed incomparable to other years.

University Hospital Arnau de Vilanova (UHAV) is the reference hospital of a health region with approximately 400,000 people as it is the only public hospital in the region that treats general emergencies.

2.2 Inclusion and exclusion criteria

Inclusion: All patients admitted to the emergency department (ED) of the UHAV who subsequently died during their stay at the ED, between 01 January 2021 and 30 September 2022, aged 18 or over.

To determine the patients who died in the emergency department, all cases that concluded in the death of the patient were reviewed according to the official hospital records submitted to the Ministry of Health. For all deceased patients, the cause of death recorded in the clinical report was reviewed to avoid loss of information.

Patients under 18 years old were excluded.

2.3 Variables

We evaluated different variables:

- Sociodemographic variables such as: age, sex, body mass index.
- Cause of death: using the cause recorded in the patients' clinical report. Both researchers reviewed the clinical reports and registered cause of death.
- Clinical background with pre-existing comorbidities: history of arterial hypertension, diabetes mellitus, Chronic Obstructive Pulmonary Disease (COPD), myocardial infarction, stroke or cancer.
- Other risk factors: smoker or alcohol consumption.
- Triage level based on the Spanish Triage System [8]: no triage 0, resuscitation 1, emergent 2, urgent 3, less urgent 4, non-urgent 5.
- Vital signs on arrival at the ED: heart rate, respiratory rate, temperature (in degrees Celsius), blood pressure (mmHg).
- Emergency laboratory results: serum lactate, serum creatinine, hemoglobin, platelet count, leukocyte count.
- Length of stay (from admission to exitus) in the ED.
- Time from admission to triage in minutes.

2.4 Data management

All clinical information was obtained during the visit to the emergency department during which the patients died. The information was collected by the research team. Patient results and information were managed according to the recommendations of our ethics committee. The processing, communication, and transfer of the personal data of all participating subjects complied with the provisions of Spanish Organic Law 3/2018, on the Protection of Personal Data and Guarantee of Digital Rights (LOPD-GDD 3/2018) and Regulation 2016/679 (EU) of the European Parliament and of the Council of Europe of 27 April 2016.

2.5 Statistical analysis

Mortality rates were calculated, followed by univariate analysis. A comparison between the study years was performed. The bivariate analysis included the chi-square test to evaluate the relationship with qualitative variables and the Kruskal-Wallis test to evaluate the relationship with quantitative variables. Quantitative variables are reported by median and the interquartile range. Additionally, a bivariate analysis was conducted based on the cause of death and triage level, according to survival. Finally, correlation with survival time was assessed by calculating Spearman correlations between quantitative variables and survival time from admission. Statistical significance was considered when $p < 0.05$. R software was used for statistical analysis (version 4.2.3, Foundation for Statistical Computing, Vienna, Austria).

3. Results

In 2021, 65,322 patients were attended to in the emergency department while for the 2022 study period, the figure stood at 51,548. Fig. 1 is a flowchart presenting the patients included in the study.

The profile of a patient who dies in the emergency department is an elderly male (>80 years old) coming from their home with a triage level indicating a risk to life (urgent or emergent), presenting cardiovascular risk factors, and dying from a respiratory cause.

317 people died during the study period of whom 54.3% were men and 45.7% were women. 182 people died in 2021, and 135 in 2022.

The mortality rate in 2021 per 1000 emergency department admissions was 2.786, 95% Confidence Interval (CI) = (2.397–3.221). The mortality rate in the first 9 months of 2022 per 1000 emergency department admissions was 2.619, 95% CI = (2.196–3.099). To compare the rates between the two years, we calculated the mortality rate in the first nine months of 2021 per 1000 emergency department admissions, which was 2.641, 95% CI = (2.204–3.139). Therefore, we observed a higher mortality rate in 2022. The mortality rate for the first nine months of 2022 compared to 2021 was 0.992, 95% CI = (0.773–1.273), with a p-value of 0.9457. The month with the greatest differences was July, with a mortality rate ratio of 1.6 in 2022 compared to 2021, 95% CI = (0.811–3.264), with a p-value of 0.1471. Although statistical significance was not achieved, a peak was observed in July 2022 (Fig. 2).

Table 1 describes the characteristics of patients who died in the emergency department in 2021 and 2022. Although there were no statistically significant differences, the average age increased in 2022, coinciding with an increase in mortality among individuals older than 80 years of age. Mortality increased by 6.2% in males and decreased by 6.2% in females in 2022.

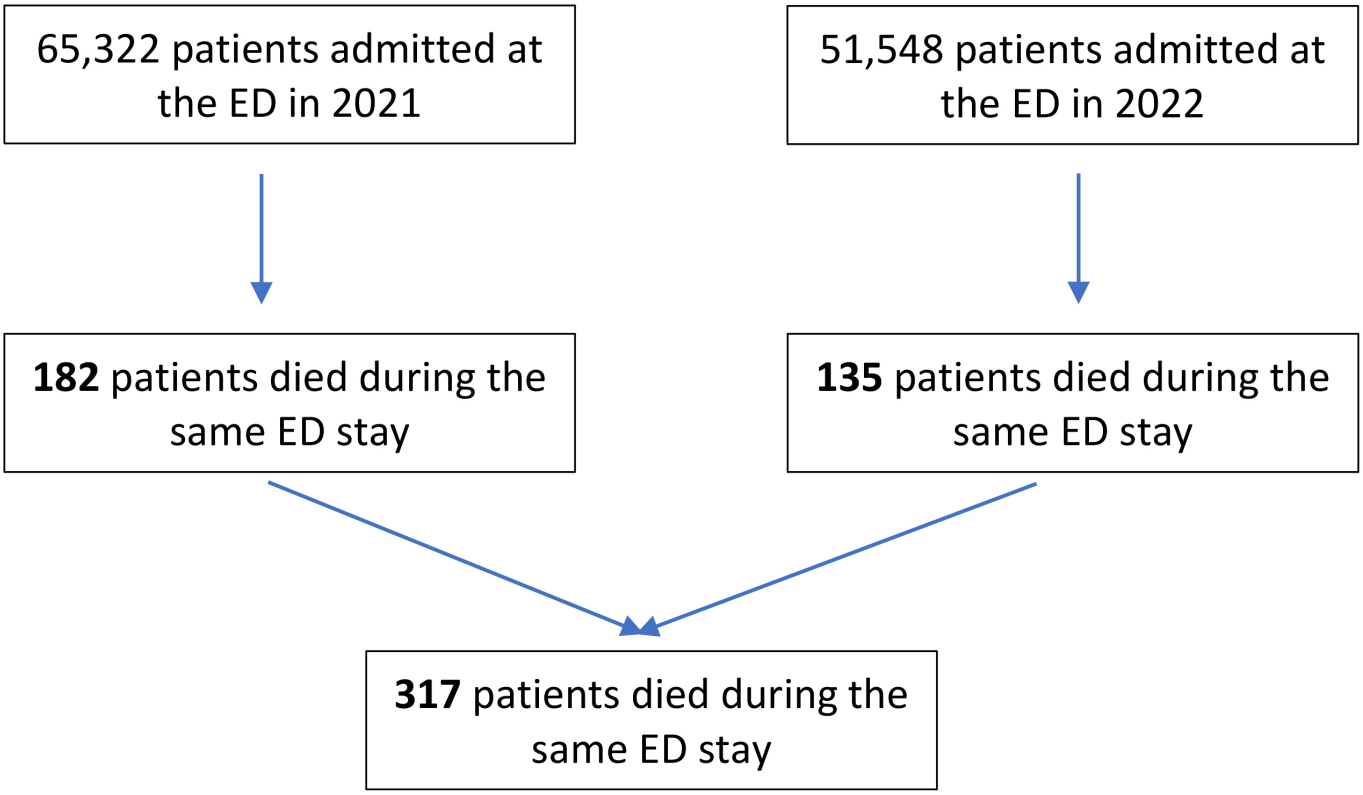

FIGURE 1. Flowchart of patients' inclusion in the study. ED: emergency department.

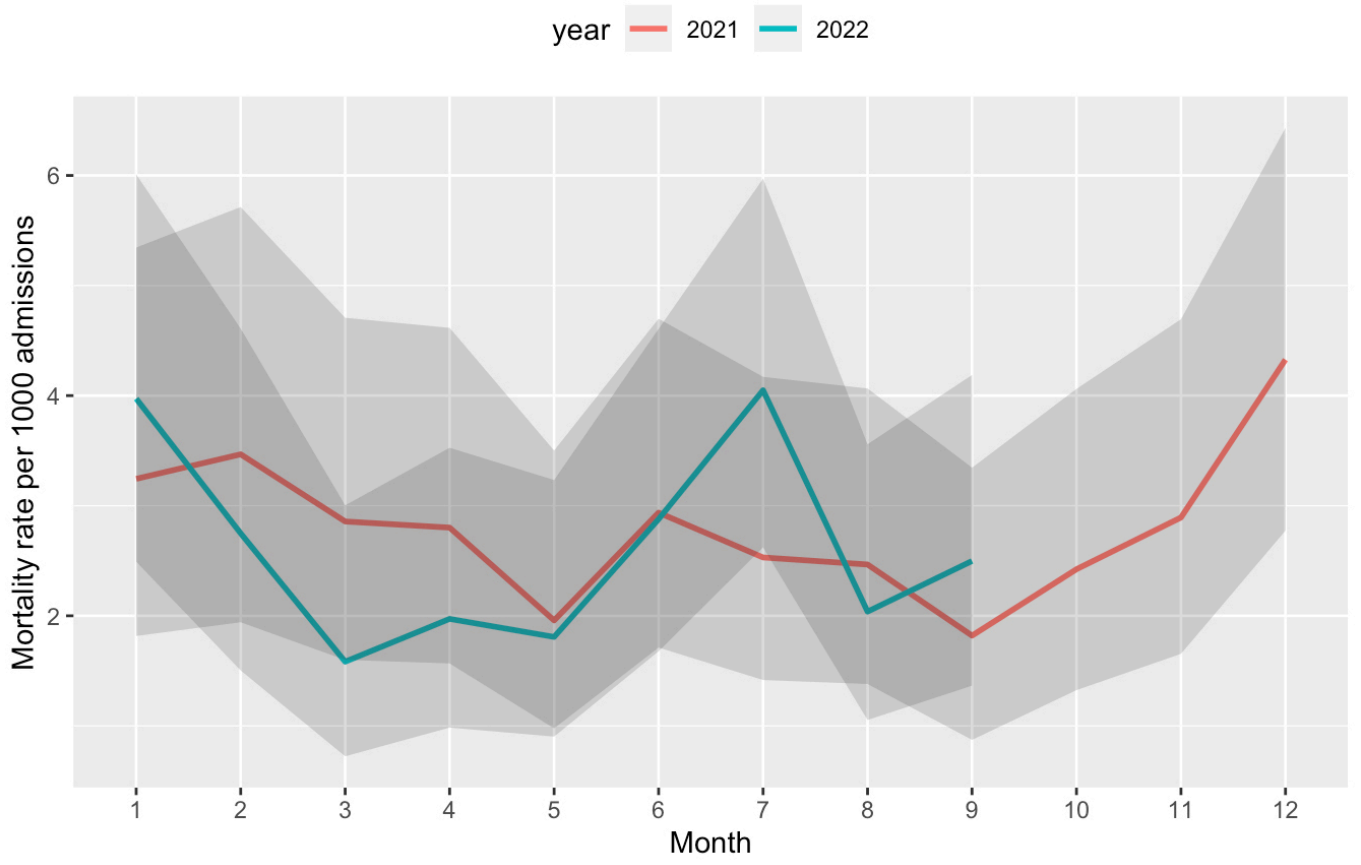

FIGURE 2. Mortality rate during the study period.

Clinical variables did not show many significant changes, although, in 2022, patients exhibited a significantly higher heart rate and respiratory rate, as shown in Table 2.

Comorbidities and cardiovascular risk factors predominantly increased in 2022. There were more patients with overweight and obesity, dyslipidemia, diabetes mellitus, and smokers, but the number of hypertensive patients decreased. The incidence of drug abuse and alcoholism among patients decreased compared to 2021. Patients who attended in 2022 had significantly fewer previous renal and neurological conditions.

The main cause of death in both years was respiratory, and it was statistically significant ($p = 0.013$). In 2022, there was a significant increase in deaths caused by shock ($p = 0.013$) and a significant reduction in deaths due to hematological causes. This is consistent with the results obtained for heart rate and respiratory rate.

Finally, Table 3 shows the Spearman correlations between quantitative variables and survival time from admission to the emergency department. Only age shows a statistically significant correlation.

4. Discussion

The profile of patients who die in the emergency department has not changed in these two years. It continues to be an elderly male patient who will die from a respiratory cause, coming from their home with a triage level indicating a risk to life (urgent or emergent) and presenting cardiovascular risk factors, especially hypertension. Additionally, upon arrival, they exhibit tachycardia and tachypnea, and there is a need to monitor oxygen saturation, renal function, and lactate levels.

Based on the findings comparing triage level with other variables, we can conclude that patients aged 65 or over, admitted from the community, and with hypertension, should be expected to have a higher level of severity (which is the basis of triage). This can help us in terms of organizing personnel and material resources. The treatment of hypoxia is also related to improved survival. It is possible that increased early alteration of vital signs may lead to more accurate healthcare management.

Various studies exist that evaluate clinical factors associated with death in the geriatric population. Our study, however, does so after the SARS-COV2 pandemic which, as described, has highlighted many problems of fragility, and has caused an

TABLE 1. Sociodemographic variables.

	(All) N (%)	2021 N (%)	2022 N (%)	*p*-overall	N
Age (median)	85.0 [76.0; 89.0]	84.0 [77.2; 89.0]	86.0 [75.0; 90.0]	0.219	317
Gender					
Male	172 (54.3%)	94 (51.6%)	78 (57.8%)	0.332	317
Female	145 (45.7%)	88 (48.4%)	57 (42.2%)		
Origin					
Home/residency	188 (59.3%)	109 (59.9%)	79 (58.5%)		
Nursing home	80 (25.2%)	40 (22.0%)	40 (29.6%)		
Primary care	14 (4.42%)	10 (5.49%)	4 (2.96%)		
Public road	16 (5.05%)	9 (4.95%)	7 (5.19%)		
Outpatient department	2 (0.63%)	1 (0.55%)	1 (0.74%)	0.679	317
Other facilities	14 (4.42%)	10 (5.49%)	4 (2.96%)		
Emergency department[+]	1 (0.32%)	1 (0.55%)	0 (0.00%)		
Penitentiary	1 (0.32%)	1 (0.55%)	0 (0.00%)		
Day care unit. major out-patient surgery	1 (0.32%)	1 (0.55%)	0 (0.00%)		
Triage level					
5—Non-urgent	9 (2.84%)	6 (3.30%)	3 (2.22%)		
4—Less urgent	9 (2.84%)	5 (2.75%)	4 (2.96%)		
3—Urgent	6 (1.89%)	3 (1.65%)	3 (2.22%)	0.650	317
2—Emergent	124 (39.1%)	67 (36.8%)	57 (42.2%)		
1—Resuscitation	115 (36.3%)	73 (40.1%)	42 (31.1%)		
0—No triage	54 (17.0%)	28 (15.4%)	26 (19.3%)		

[+]: *People who were in the Emergency Department accompanying patients.*

TABLE 2. Clinical variables of patients who die in the ED.

	All	2021	2022	*p*-overall
Heart rate	96.5 [76.0; 120]	92.0 [75.0; 114]	102.0 [78.8; 122]	0.105
Systolic blood pressure (mmHg)	109 [80.0; 142]	110 [80.0; 136]	108 [80.0; 145]	0.731
Diastolic blood pressure (mmHg)	65.0 [50.0; 78.0]	68.0 [49.0; 79.0]	63.0 [50.0; 76.5]	0.494
Temperature (°C)	36.0 [35.1; 36.8]	36.0 [35.1; 36.7]	36.0 [35.2; 37.0]	0.985
Basal oxygen saturation (%)	90.0 [83.0; 96.0]	92.0 [84.0; 96.0]	90.0 [80.0; 95.5]	0.660
Respiratory rate	31.5 (10.00)	29.2 (10.10)	34.2 (9.36)	0.014
Hemoglobin (g/dL)	12.2 [10.2; 13.9]	11.9 [10.1; 13.7]	12.4 [10.6; 14.3]	0.167
Leukocytes ($\times 10^9$/L)	12.6 [8.76; 17.2]	13.4 [9.12; 17.5]	11.9 [8.22; 16.6]	0.178
Platelets ($\times 10^9$/L)	204 [148; 288]	215 [151; 294]	198 [146; 274]	0.303
Seric creatinine (mg/dL)	1.52 [1.00; 2.00]	1.42 [0.99; 1.98]	1.58 [1.00; 2.02]	0.780
Arterial lactate (mmol/L)	3.20 [1.50; 6.77]	2.45 [1.30; 6.33]	3.75 [2.05; 7.30]	0.019

All the variables are presented with median and interquartile range, except Respiratory rate (mean and SD).

TABLE 3. Spearman correlations between quantitative variables and survival time from admission.

	Spearman's rho	*p*-overall
Age	0.1196	0.0333
Minutes to the start of assistance	0.0961	0.0924
Hemoglobin (g/dL)	−0.0580	0.3212
Leukocytes ($\times 10^9$/L)	−0.0685	0.2407
Platelets ($\times 10^9$/L)	−0.0372	0.5247
Seric creatinine (mg/dL)	0.0980	0.0940
Arterial lactate (mmol/L)	−0.1245	0.0692
Heart Rate	−0.1155	0.0791
Systolic blood pressure (mmHg)	0.0472	0.4646
Diastolic blood pressure (mmHg)	0.0326	0.6187
Temperature (°C)	−0.0686	0.3657
Respiratory rate	−0.0788	0.4407
Basal oxygen saturation (%)	0.0591	0.4388

increase in the complexity of the patients attended to in the emergency department, at least in Spain [14].

Compared to other studies, conducted in African and Asian countries, which claim to have observed modifications in prognosis based on this triage level and the alteration of vital signs [4], our average age at death is much higher, and the triage level is predominantly distributed at level 3 (urgent). This is probably because in Spain there is no limitation on access to public hospital emergency departments. For this reason, this study is important as it is the first to evaluate common factors in patients that die, especially geriatric patients.

At the European level, the correlation between vital sign abnormalities and specific causes of death has also been demonstrated [3, 12]. However, further research is needed in this area, because the profile of patients is changing. Patients attending the emergency department are increasingly elderly and fragile [15].

For studies in Spain, there is agreement in terms of average age, gender, predominant triage level, and the main cause of death in the emergency department. In one particular study, there is mention of a possible triage bias in patients coming from nursing homes, as they all have a low triage level and high mortality, which is not the case in our study [10]. Hence, we believe our study contributes evidence in a field with a major impact on healthcare in the coming years.

In our study, we were unable to directly demonstrate at what waiting time until triage the mortality of patients increases, as in other studies [6]. However, indirectly, we observe that the decrease in the mortality rate in 2022 is accompanied by a reduction in the time from admission to triage.

At present, there are different severity scales associated with triage in the emergency department [16], especially for trauma patients [17]. However, none have been developed specifically for elderly patients, at least in Spain. Since the age of the patients attended to has increased considerably, we believe that it is important to have a tool to determine which patients really require emergency care or may even be referred to other healthcare resources. Moreover, new tools are continuously emerging, such as 3D/3D+, a tool for rapid geriatric assessment of the suitability of the care resource upon discharge from the emergency department, especially based on the patient's social environment [18].

Due to the extensive range of variables analyzed and the few exclusion criteria, we may encounter selection bias and the presence of confounding variables, and unknown third variables that may influence the results. Retrospective data can be influenced by registration errors, which can affect the accuracy of the results, introducing information bias. Moreover, it should be taken into account that in 2021, especially in the

early months, we were suffering the SARS-COV2 pandemic, which may have affected the results. However, as an element of great strength, we believe that given the characteristics of our hospital and the profile of our patients, our results can be extrapolated and applied to the emergency departments in our country.

5. Conclusions

The following parameters were consistently present in the death of our patients over the two years: hypotension, tachypnea, hypoxia, elevated creatinine, and lactate. Moreover, the average age of death has increased, with a rise in mortality among men. We believe it could be useful to create a score related to the death of elderly patients after triage. If performed within the first hour of the patient's arrival at the emergency department, it could help us provide higher-intensity care and surveillance in cases of imminent risk of death. Therefore, it is crucial to obtain reliable vital signs at the time of triage and ensure they are recorded accurately.

Given the increasing use of emergency department services by older patients with multiple comorbidities, it may be beneficial to have a diagnostic risk score to determine the level of treatment intensity required in the emergency department, including such clinical variables and others like gender, risk factors and triage.

AVAILABILITY OF DATA AND MATERIALS

All data generated or analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

MS—was responsible for data management and database creation. OY—wrote the draft and reviewed the paper and was responsible for project conceptualization. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

All the research was performed in accordance with relevant guidelines and regulations (such as the Declaration of Helsinki). The study was reviewed and approved by the IRBLLEIDA Ethics Committee, with ID CEIC-2742. The study has been granted an exemption from requiring written informed consent approved by the IRBLLEIDA Ethics Committee.

ACKNOWLEDGMENT

Not applicable.

FUNDING

This research received no external funding.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Hollander J, Sharma R. The availablists: emergency care without the emergency department. NEJM Catalyst Innovations in Care Delivery. 2021; 6: 1–13.

[2] Ministerio de Sanidad y Consumo. Standards and recommendations. 2010. Available at: https://www.sanidad.gob.es/organizacion/sns/planCalidadSNS/pdf/equidad/informeAnual2010/informeAnualSNS2010.pdf (Accessed: 01 September 2022).

[3] Julián-Jiménez A, Rubio-Díaz R, González del Castillo J, García-Lamberechts EJ, Huarte Sanz I, Navarro Bustos C, *et al*. Ability of qSOFA1-lactate to predict 30-day mortality in patients seen for infection in the emergency department. Spanish Journal of Chemotherapy. 2023; 36: 408–415. (In Spanish)

[4] Simbawa JH, Jawhari AA, Almutairi F, Almahmoudi A, Alshammrani B, Qashqari R, *et al*. The association between abnormal vital signs and mortality in the emergency department. Cureus. 2021; 13: e20454.

[5] Makonnen N, Layng T, Hartka T. Comparison of mortality in emergency department patients with immediate versus delayed hypotension. The American Journal of Emergency Medicine. 2023; 72: 1–6.

[6] Jones S, Moulton C, Swift S, Molyneux P, Black S, Mason N, *et al*. Association between delays to patient admission from the emergency department and all-cause 30-day mortality. Emergency Medicine Journal. 2022; 39: 168–173.

[7] Af Ugglas B, Lindmarker P, Ekelund U, Djärv T, Holzmann MJ. Emergency department crowding and mortality in 14 Swedish emergency departments, a cohort study leveraging the Swedish Emergency Registry (SVAR). PLOS ONE. 2021; 16: e0247881.

[8] Jiménez J, Olaya FB, Cremidis OB, Cortés EA, Garrigós JBF, Prats MM. Clinical validation of the new version of the triage assistance program (web_e-PAT v3) of the Andorran triage model (MAT) and Spanish Triage System (SET). Reliability, usefulness and validity in the paediatric and adult population. Emergencias. 2006; 18: 207–214.

[9] Lu Y, Ren C, Wu C. In-hospital mortality prediction model for critically ill older adult patients transferred from the emergency department to the intensive care unit. Risk Management Healthcare Policy. 2023; 16: 2555–2563.

[10] Gunnarsdottir OS, Rafnsson V. Mortality of the users of a hospital emergency department. Emergency Medicine Journal. 2006; 23: 269–273.

[11] Martín-Rodríguez F, Ortega GJ, Castro Villamor MA, del Pozo Vegas C, Delgado Benito JF, Martín-Conty JL, *et al*. Development of a prehospital lactic acidosis score for early-mortality. A prospective, multicenter, ambulance-based, cohort study. The American Journal of Emergency Medicine. 2023; 65: 16–23.

[12] Wessman T, Ärnlöv J, Carlsson AC, Ekelund U, Wändell P, Melander O, *et al*. The association between length of stay in the emergency department and short-term mortality. Internal and Emergency Medicine. 2022; 17: 233–240.

[13] Ortiz SS, Huang Y, Rowe BH, Zheng B, Rosychuk RJ. Emergency department crowding negatively influences outcomes for adults presenting for chronic obstructive pulmonary disease. Canadian Journal of Emergency Medicine. 2023; 25: 411–420.

[14] Aguirre NL, Gutiérrez SG, Miro O, Aguiló S, Jacob J, Alquézar-Arbé A, *et al*. Older adult patients in the emergency department: which patients should be selected for a different approach? Annals of Geriatric Medicine and Research. 2024; 28: 9–19.

[15] Afonso-Argilés FJ, Comas Serrano M, Blázquez-Andión M, Castells Oliveres X, Cirera Lorenzo I, García Pérez D, *et al*. Factors associated with short-term mortality after emergency department care of residents living in aged care homes: findings from the multicenter Caregency study. Emergencias. 2022; 34: 437–443.

[16] Sakamoto JT, Liu N, Koh ZX, Guo D, Heldeweg MLA, Ng JCJ, *et al*. Integrating heart rate variability, vital signs, electrocardiogram, and troponin to triage chest pain patients in the ED. The American Journal of

Emergency Medicine. 2018; 36: 185–192.
[17] Saberian SM, Chester DJ, Udobi KF, Childs EW, Danner OK, Sola R. A comparative analysis of hospital triage systems in the geriatric adult trauma patients: a quality improvement pilot study. The American Surgeon. 2023; 89: 2300–2305.
[18] Garcia-Pérez D, Robles-Perea L, Vena-Martínez A, Arnau A, Robles-Bernabeu G, Espaulella-Panicot J. 3D/3D+ as a tool for rapid geriatric assessment and adequacy of the care resource at discharge from the emergency department. Spanish journal of Geriatrics and Gerontology. 2022; 57: 212–219. (In Spanish)

How to cite this article: Marina Serra, Oriol Yuguero. Clinical factors of patients who die in an emergency department: the significance of early clinical data, especially for the elderly. Signa Vitae. 2024; 20(7): 53-59. doi: 10.22514/sv.2024.083.