

Mortality prediction in cancer patients in intensive care. A single-center study

*Correspondence:

kashir_12@hotmail.com

Av. Samborondón 5, Samborondón 092301, Guayaquil-Ecuador. Edificio de Posgrados, Facultad de Ciencias Médicas "Enrique Ortega Moreira", Universidad de Especialidades Espíritu Santo. Teléfono [593] 04 500-0950. Ext 9010

Conflict of interest: The authors declare that they have no conflict of interest.

Received: March, 24 2022

Accepted: July 2, 2022

Published: August 2, 2022

Editor: Dra. Evelyn Valencia Espinoza

Cite:

Ojeda K, Rivera T. Mortality prediction in cancer patients in intensive care. A single-center study. Rev. Oncol. Ecu 2022;32(2):129-140.

DOI: <https://doi.org/10.33821/622>

 Copyright Ojeda K, et al. This article is distributed under the terms of the [Creative Commons Attribution License BY-NC-SA 4.0](https://creativecommons.org/licenses/by-nc-sa/4.0/), which permits use and redistribution provided the original author and source are cited.

Mortality prediction in cancer patients in intensive care. A single-center study

Karen Sirley Ojeda Delgado* ¹ , **Tannia Rivera Rivera** ² 

1. Postgraduate Faculty, medical specialty in Internal Medicine, "Enrique Ortega Moreira" Faculty of Medical Sciences, Espíritu Santo University of Specialties, Sanborondón, Ecuador.
2. Intensive Care Unit, National Oncology Institute "Dr. Juan Tanca Marengo," Society for the Fight Against Cancer (Solca), Guayaquil, Ecuador.

Summary

Introduction: The mortality of cancer patients admitted to an intensive care unit can be estimated using sepsis scales. The objective of the present study was to carry out a diagnostic test between the main scales in a group of cancer patients from a reference center in Guayaquil-Ecuador.

Methodology: A cross-sectional study was carried out in the intensive care unit of the National Oncology Institute "Dr. Juan Tanca Marengo" of SOLCA-Guayaquil from October 2019 to November 2020. The sample was probabilistic of patients with clinical oncological diagnoses. Admitted to the ICU. Age, type of cancer, family history, mortality, and SOFA and APACHE II scores were recorded. Descriptive statistics were used, and a diagnostic test and a survival analysis were performed.

Results: Ninety-nine cases were analyzed, 57 ± 16 years old, and 37 were men (37.4%). Arterial hypertension (39.4%) and type 2 diabetes mellitus (17.1%). A total of 12.1% of the cases were non-Hodgkin's lymphoma and intestinal cancer (11.1%), and 17 deaths occurred (17.2%). The overall SOFA score was 6.8 ± 3.0 , and the global APACHE II score was 18.6 ± 7.0 . The risk of mortality was statistically significant from the fifth day. A SOFA score >6 had a sensitivity of 88.24%, the positive predictive value (VP) was shallow, and the specificity; the negative PV was 97%. The APACHE II scale had a sensitivity of 94.12%, with a specificity of 96.34%; positive PV, compared to the SOFA scale, was double.

Conclusion: The APACHE II scale in clinical cancer patients admitted to the ICU predicts mortality more accurately when the score exceeds 18.

Keywords:

DeCS: Neoplasms, Neoplasm metastasis, Critical Care, Mortality, Hospital Mortality; Mortality Registry, Survival Analysis.

DOI: 10.33821/622

Introduction

Cancer is the leading cause of death in men and the second leading cause of death in women worldwide, with an annual mortality rate of 204 deaths per 100 thousand inhabitants [1]. The causes of death derive from complications due to immunosuppression, either due to the disease itself or as a consequence of adjuvant therapy; sepsis of respiratory and urinary origin is frequent in these patients. In Ecuador, the leading causes of death from cancer correspond to entities such as breast cancer, colorectal cancer, and prostate cancer [2]. To determine the mortality prognosis of these patients, scales such as Sequential Organ Failure Assessment (SOFA) and Acute Physiology And Chronic Health Evaluation II (APACHE II) were used, each with sensitivity and specificity in predicting mortality.

In Ecuador, few studies on this subject provide insufficient data to validate the accuracy of these scales in our environment. However, new evidence indicates that a SOFA over 6 points and APACHE II over 10 are highly predictive of mortality, as stated [3] (OR 1.26; 95% CI: 1.10-1.43). Based on the above, the development of this research work is proposed, whose objective is to analyze the use of APACHE II and SOFA scores as predictors of mortality in clinical oncology patients admitted to the intensive care room of the SOLCA Hospital in the city of Guayaquil. Furthermore, survival analysis was performed. It is considered that research of this nature can contribute to improving the standards of medical care in patients with catastrophic illnesses. It is also estimated from the present that multicentric research of an application type can be carried out in the medium term, allowing the generation of scientific knowledge based on local casuistry.

Materials and methods

Study design

This study is observational and cross-sectional. One part of the study was correlational.

Study area

The study was carried out in the intensive care room of the National Oncology Institute "Dr. Juan Tanca Marengo" of the Society for the Fight Against Cancer – SOLCA, in Guayaquil, Ecuador. The study period was the files registered from October 1, 2019, to February 28, 2020. The study ended on November 27, 2020.

Universe and sample

The population was made up of patients admitted to the intensive care unit of the institution. For the sample calculation, the following formula was used for finite populations:

$$n = \frac{N \cdot Z_{\alpha}^2 \cdot p \cdot q}{d^2 \cdot (N - 1) + Z_{\alpha}^2 \cdot p \cdot q}$$

where n = is the size of the population to be determined, Z_{α} = confidence level of 1.96, P = expected proportion of 0.5, $q = (1 - p)$ probability of failure 0.5, and d = precision of 0.05. The estimated number was 90 cases.

Participants

Adult patients admitted for the first time to the institution's intensive care unit with primary clinical diagnoses of cancer were included. Patients in the postoperative oncological period were excluded, and records with incomplete data were excluded from the analysis.

Variables

Sociodemographic variables are included: age, schooling, and sex. Clinical variables: type of cancer and staging, comorbidity, ECOG Scale, and treatment. SOFA scale, APACHE II scale, mortality, cause of death, days of hospitalization.

Procedures, techniques, and instruments.

The data were collected from the clinical history in a form designed exclusively for that purpose. The institutional electronic system was used for case investigation. The following root codes of the ICD-10 international classification related to malignant neoplasms (C00-C97) were used. The database was coded with serial numbers, thus protecting the confidentiality of the information and identity of the patients.

Bias avoidance

To guarantee the reliability of the information, the researchers were trained in data collection. A double checklist was used to include all cases. The data were validated and curated by the researchers KO and TR. To avoid possible interviewer, information, and memory biases, the principal investigator guarded the data at all times with an appropriate guide and records. Observation and selection bias was avoided by applying the participant selection criteria. All the clinical and paraclinical variables of the hemodialysis sessions of the period mentioned above were recorded. Two researchers independently analyzed each record in duplicate, and the variables were recorded in the database once their agreement was verified.

Statistical analysis

Univariate analysis of the sample was performed. A secondary analysis presents a study of diagnostic tests between the SOFA and APACHE II variables concerning mortality. The third survival analysis is presented. The statistical package used was SPSS version 21.0 for PC (Armonk, NY: IBM Corp.), licensed by the University of Espiritu Santo Specialties.

Results

Study participants

The study included 99 analyzable cases (Figure 1).

Sample characterization

The average age of the group was 57 ± 16 years, with a minimum value of 18 and a maximum of 88 years. There were 37 men (37.4%) and 62 women (62.4%). The most frequent comorbidities were arterial hypertension and type 2 diabetes mellitus (Table 1). Within the etiology of neoplasms, cases of non-Hodgkin's lymphoma and intestinal cancer were the most prevalent (Table 2).

Table 1. Comorbidities and medical history in the study group.

	n=99	Percentage	Accumulated percentage
Family history of Ca	27	27.3%	27.3%
Arterial hypertension	39	39.4%	66.6%
Mellitus diabetes	17	17.2%	83.8%
smoking	5	5.1%	88.9%
environmental exposure	5	5.1%	94.1%
hypothyroidism	3	3.0%	97.0%
ischemic stroke	two	2.0%	99.0%
HIV	1	1.0%	100%

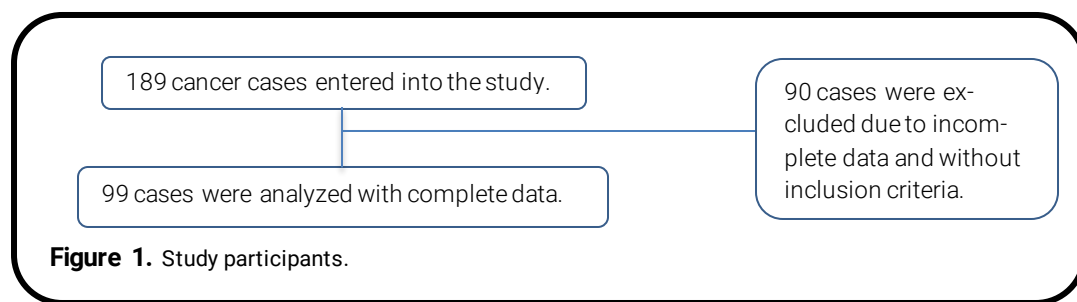
Ca: Cancer, CVA: Cerebrovascular Accident, HIV: Human Immunodeficiency Virus.

Table 2. Etiology of neoplasms in study patients.

	n=99	Percentage	Accumulated percentage
Hodgkin lymphoma	12	12.1%	12.1%
Bowel Ca	eleven	11.1%	23.2%
Brain ca	8	8.1%	31.3%
Breast ca	8	8.1%	39.4%
Skin ca	7	7.1%	46.5%
Thyroid ca	5	5.1%	51.6%
Leukemia	5	5.1%	56.7%
Ca of cervix	4	4.0%	60.7%
Ca of tongue	4	4.0%	64.7%
Ovary ca	4	4.0%	68.7%
Lung ca	4	4.0%	72.7%
Hepatic Ca	4	4.0%	76.7%
Kidney Ca	4	4.0%	80.7%
Stomach ca	3	3.0%	83.7%
Pancreatic ca	3	3.0%	86.7%
Amygdala ca	two	2.0%	88.7%
Vagina ca	two	2.0%	90.7%
Bladder ca	two	2.0%	92.7%
Esophageal ca	1	1.0%	93.7%
Ca of endometrium	1	1.0%	94.7%
Ca of penis	1	1.0%	95.7%
Bronchial neuroendocrine Ca	1	1.0%	96.7%
Eye ca	1	1.0%	97.7%
Meningioma	1	1.0%	98.7%
Oligodendroglioma	1	1.0%	100%

Ca: Cancer.

In 69 cases (69.7%), the neoplasia was locoregional, and 30 cases (30.3%) corresponded to metastatic cases. The leading site of metastasis observed in the study population was Lymph node with 64 cases (65.46%), followed by Lung (10 cases) and Intestine (10 cases), Bone with 6 cases (6.1%), Hepatic with 5 cases (5.1%), Pancreas and Brain with 2 cases each. The average time of disease with cancer in the study population was 5 ± 2 years, the minimum time of the disease was one year, and the maximum was 16 years.



Mortality assessment scales

There were 17 deaths (17.2%). The SOFA scale score of the group was 6.8 ± 3.0 (minimum 2, maximum 11). The APACHE II scale score was 18.6 ± 7.0 (minimum 4, maximum 34) (Figure 2). The scales are presented in table 3.

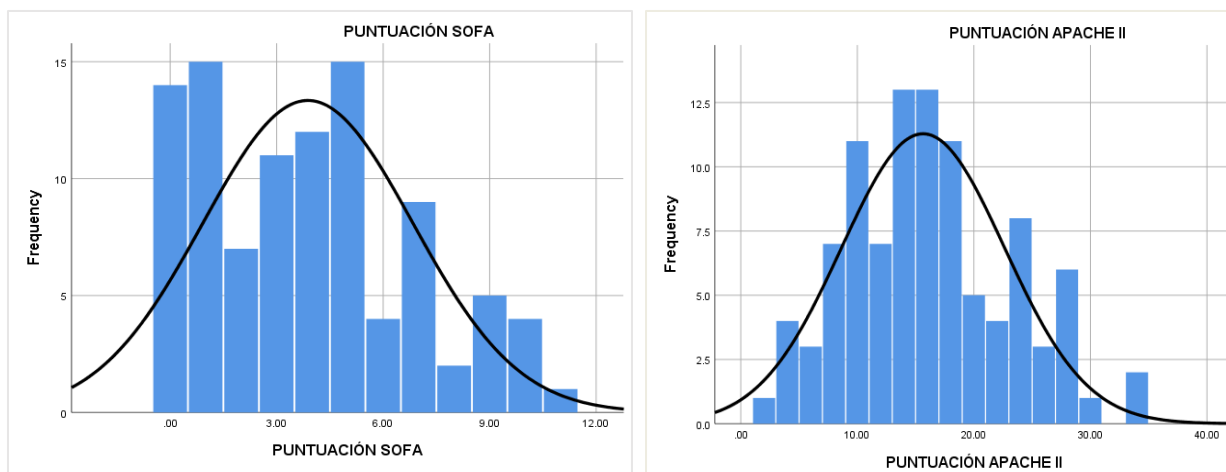


Figure 2. Histograms of the SOFA and APACHE II variables.

Table 3. APACHE II and SOFA Scale Components in Study Participants.

	Apache II	SOFA
Respiratory rate (per min)	18.2	
Platelets (u/uL)	244.67 ± 51.6	
Bilirubins (mg/dL)	3.03 ± 1.08	
Mean arterial pressure (mmHg)	79.31 ± 13.35	
Glasgow	12.29 ± 3.40	
Creatinine (mg/dL)	1.39 ± 1.45	
Temperature (°C)	36.94 ± 1.89	
SPO2 (mmHg)	94.53 ± 5.94	
pH	7.38 ± 0.11	
Na (mEq/L)	138.4 ± 5.12	
K (mEq/L)	4.0 ± 0.73	
Hct (%)	32 ± 6	
WBC (u/uL x 1000)	14.2 ± 9.49	

WBC: White blood cells.

Survival estimate

The risk of mortality due to cancer in patients in the intensive care unit was statistically significant from the fifth day of hospital stay with an asymptotic significance of 0.0697 when the SOFA scales had a mean of 6 points and for APACHE a score equivalent to 18 (Figure 3).

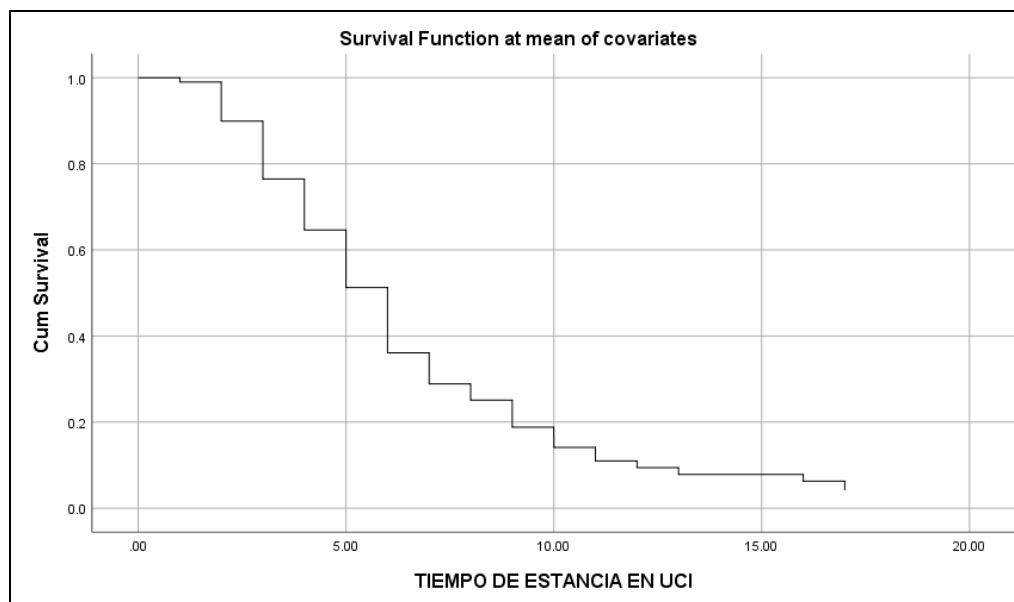


Figure 3. Survival function in patients with mortality event. Time in days.

Diagnostic tests

The SOFA scale had a sensitivity of 88.24% when its value was equal to or greater than 6 points; the positive predictive value was meager, as was the specificity (Table 4); the negative predictive value for SOFA >6 was 97%. The APACHE II scale had a sensitivity of 94.12%, with a specificity of 96.34%; it was observed that the positive predictive value, compared to the SOFA scale, was double (Table 4). The ROC curve is presented in figure 4.

Table 4. Diagnostic tests.

		Deceased n=17	alive n=82	Sensitiv- ity	specficity	PPV	NPV
COUCH	>6	15 (88.2%)	17 (20.7%)	88.24%	79.27%	46.88%	97.01%
	<6	2 (11.8%)	65 (79.3%)				
Apache II	>18	16 (94.12%)	3 (3.66%)	94.12%	96.34%	84.21%	98.75%
	<18	1 (5.88%)	79 (96.34%)				

PPV: Positive predictive value. NPV: negative predictive value

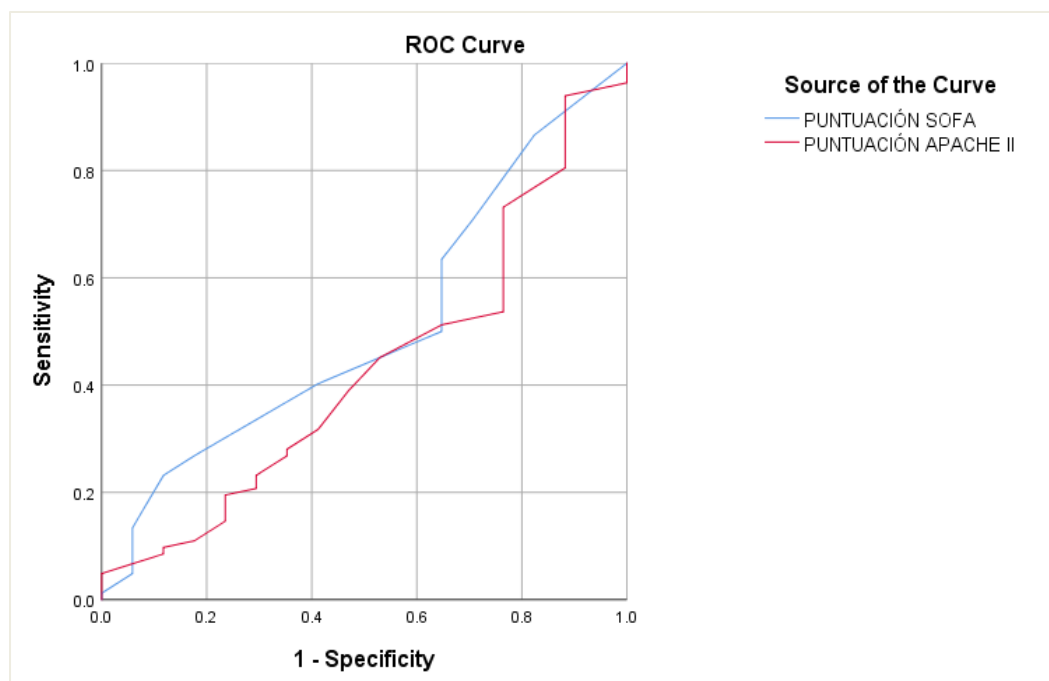


Figure 4. ROC curve of the SOFA and APACHE II scales for predicting mortality in cancer patients in the ICU.

Discussion

The results of the present investigation show that the average length of hospital stay in oncology patients admitted to the intensive care unit (ICU) of the SOLCA Hospital in Guayaquil was five days. These data are comparable to those previously reported [3], who showed that the average hospitalization time was approximately nine days in a study on cancer patients admitted to 18 different ICUs. The leading causes of his admissions were postoperative complications and acid-base imbalance. Refractory hypotension, pneumonia.

It was also observed that male patients were predominant with a 2:1 ratio, and the primary diagnoses were non-Hodgkin's lymphoma, intestinal cancer, and brain cancer. In the study by Díaz-Díaz et al. [3], 62.9% of the patients were men, similar to the present study. According to the same author, solid tumors were frequent with 79%.

The most frequent solid tumors observed were gastrointestinal (38.3%), genitourinary (20.4%), and lung (10.2%) tumors. Of the hematological tumors, the most frequent were lymphoma (15.9%), leukemia (7.8%) and multiple myeloma (3.6%). Based on the mortality variable, 82.8% survived during their stay in the SOLCA Guayaquil ICU, while 17.2% did not, with a total of 17 cases. These data are similar to those reported by Probst et al. (2019) [4], who, in a study on the prognostic accuracy of the SOFA, qSOFA, and SIRS criteria in cancer patients, showed that out of 450 patients (15.63%) who corresponded to a total of 70 cases died during their

stay in the ICU, the causes of death were multiorgan failure, AKIN III renal failure, and creatinine levels > 5 mg/dl.

The SOFA scores had a mean of 6.8 points with a standard deviation of ± 2.95 , while the APACHE scores had mean values of 18.6 points with a standard deviation of ± 6.99 . These data are related to those reported by (Díaz-Díaz et al., 2018) [3], who observed mortality when the APACHE II score was 21 points, SAPS-II 75 points, and SOFA 8 points. In a study [4] in patients with qSOFA ≥ 2 , mortality was 49% compared to 33% for those with qSOFA < 2 ($P = 0.056$). With the SOFA scale, mortality was 56% with a value of 6.2 points ($P < 0.001$), so it was concluded that SOFA allowed a significantly better discrimination for hospital mortality (AUROC 0.74 [95% CI, 0.69–0.79] $P < 0.001$). For his part (Bermejo González, 2017) [5] considers that the correlation between SOFA and APACHE II is adequate for predicting mortality in both solid and nonsolid tumors; when SOFA is equal to 6 points, 22 points for APACHE II and 2.08 ng/ml for procalcitonin. (Escudero & Sofía, 2018) [6] showed that a SOFA score of 6 confers an RR for death = 5:1. According to this author, SOFA scores = 8 points, APACHE II scores ≥ 21 points, and IL 6 levels ≥ 2.30 ng/ml are highly predictive of mortality in cancer patients.

For Chae et al., 2020 [7], when the SOFA score was ≥ 6 and qSOFA was ≥ 2 , the mortality was 23.2% and 3%, respectively ($P < 0.001$). However, the combination of qSOFA with a lactate threshold ≥ 2 considerably improved mortality discrimination ability with an AUROC of 0.77 (95% CI, 0.69–0.85), which was similar to the SOFA score ($P = 0.11$). All these previously exposed data correlate with those obtained in the ICU - SOLCA of Guayaquil.

Concerning the general objective, which was to analyze the use of APACHE II and SOFA as predictors of mortality in clinical oncology patients in the intensive care ward of the SOLCA hospital in Guayaquil from October 2019 to February 2020, it is concluded that both scales are suitable as predictors of mortality. The asymptotic significance supports this obtained < 0.001 when applying the Cox linear regression parametric survival test, with a risk of imminent death from the fifth day of hospitalization in the ICU.

The incidence of mortality observed in cancer patients admitted to the ICU ward of the Oncology Hospital - SOLCA Guayaquil was 16.83% when the APACHE and SOLCA scales reached the average values obtained in the present investigation.

The average APACHE II score was 18 points, and the SOFA score was 6 points, which had a statistically significant association with mortality in cancer patients admitted to the Oncology Hospital - SOLCA Guayaquil ICU ward.

The prognostic validity of the APACHE II and SOFA scales through survival analysis when applying a typing test: Cox linear regression yielded an asymptotic significance of 0.001, which mathematically and statistically supports that they are adequate scales to relate the potential risk of death in cancer patients admitted to the ICU.

Finally, it was shown that both SOFA and APACHE II had adequate sensitivities, specificities, and predictive values for mortality in cancer patients admitted to SOLCA Guayaquil Hospital, with APACHE being better than SOFA, with figures for APACHE of 94.12% for sensitivity, of 96.34. % for specificity and 84.21% for PPV. For SOFA, they were 88.24% for sensitivity, 79.27% for specificity, and 46.88% for VPP.

It is considered that this research provides valuable information to timely identify those cancer patients with a high risk of mortality upon admission to the ICU of the SOLCA Hospital in the city of Guayaquil. Obtaining information of this type will allow optimization of hospital resources available when patients reach SOFA scales > 6 points and APACHE scales > 18

points based on a specific time interval, avoiding unnecessary interventions or juxtaposed intervening promptly to avoid the death of cancer patients with permissible survival rate and adequate lifestyle.

On the other hand, this research provides scientific information through the application of the scientific method and provides survival results based on mathematical models that are reproducible (COX Linear Regression) in any ICU room nationwide, which is a tool based on information obtained to modify diagnostic and therapeutic protocols. Through these data, it will be possible in the medium and long term to adapt therapeutic strategies that allow an early replacement of critically ill patients.

The data obtained in the present investigation are proposed to carry out new investigations of an applicative type in comparison with peers, that is, multicenter between different intensive care units of the city of Guayaquil, in which the usefulness of interventions in critically ill cancer patients. This will make it possible to rationalize the efforts made in cancer patients, avoiding unnecessary life extensions in seriously compromised patients where the quality of life is inadequate and, on the other hand, will make it possible to make the entire hospital contingent available to cancer patients when their survival capacity and quality of life after discharge from the ICU are optimal. It is recommended to carry out new investigations where other survival scales are integrated, such as Quick SOFA, APACHE III, and APACHE IV, as well as the usefulness of serological markers such as interleukins and procalcitonin, to standardize at the level of the city of Guayaquil which scales are the most adaptable and with a higher degree of confidence to estimate survival in patients admitted to intensive care units.

Editor's note

Revista Oncología Ecu remains neutral for jurisdictional claims on published maps and institutional affiliations.

Conclusions

The APACHE II scale in clinical cancer patients admitted to the ICU accurately predicts mortality when the score exceeds 18.

Abbreviations

SOFA: Sepsis-related Organ Failure Assessment.

APACHE II: Acute Physiology and Chronic Health disease Classification System II.

Administrative information

Additional Files

The authors declare none.

Acknowledgments

The authors thank all the people of the institutions who collaborated in the development of this research.

Author contributions

Karen Ojeda Delgado: conceptualization, validation, visualization, methodology, project management, writing: review and editing.

Tannia Rivera Rivera: conceptualization, data curation, formal analysis, fundraising, research, resources, software.

All authors read and approved the final version of the manuscript.

Financing

The authors did not receive any financial recognition for this research work. Expenses incurred in studies and laboratory tests constitute the usual expense of patients admitted to the intensive care unit and did not constitute an additional expense to patients. The authors subsidized the administrative costs of this research.

Availability of data and materials

Data availability is available upon request to the corresponding author. No other materials were reported.

Statements

Ethics committee approval

It does not apply to observational studies with databases or medical records reviews.

Consent to publication

This does not apply to studies that do not publish explicit images such as CT scans, MRIs, and physical exam images.

Conflicts of interest

The authors declare that they have no conflict of interest or competence.

References

1. Csendes A, Figueroa M. Situation of Gastric Cancer in the world and Chile. Rev Chile Cir 2017;69(6):502-507. DOI: [10.1016/j.rchic.2016.10.014](https://doi.org/10.1016/j.rchic.2016.10.014).

2. Arreaga A, Torres L. Geographic visualization of the mortality rate due to breast, cervical and prostate cancer in Ecuador. [Graduation work-Engineering career in computational systems]. Santiago de Guayaquil Catholic University Repository. 11-Sep-2017. **SU:** [3317/9059](#)
3. Díaz-Díaz D, Martínez V, Herrejón E. Cancer patients admitted to the Intensive Care Unit. Analysis of predictive factors of mortality. *Intensive Medicine* 2018;42(6):346-353. **VHL:** [178646](#).
4. Probst L, Schalk E, Liebrechts T, Zeremski V, Tzavallas A, von Bergwelt-Baildon M, et al.; Working Party on Intensive Care Medicine in Hematologic and Oncologic Patients (iCHOP) of the German Society of Hematology and Medical Oncology (DGHO). Prognostic accuracy of SOFA, qSOFA and SIRS criteria in hematological cancer patients: a retrospective multicenter study. *J Intensive Care*. 2019 Aug 7;7:41. **DOI:** 10.1186/s40560-019-0396-y. **PMID:** [31410290](#); **PMCID:** PMC6686367.
5. Bermejo N, Caputi R. Serum procalcitonin, sofa, and Apache II, as predictors of mortality in septic cancer patients, SOLCA, 2015. [Specialty thesis in Internal Medicine]. University of Guayaquil Repository, 2017. **SU:** [38048](#).
6. Echeverría I, Mina E. Comparison of interleukin-6, procalcitonin, and assessment of the SOFA score as early markers of sepsis in suspected patients admitted to the Intensive Care Unit of Hospital Northhospital. Quito: UCE. [Graduation thesis –Clinical biochemistry]. Repository of the Central University of Ecuador 2018. **SU:** [16503](#).
7. Chae BR, Kim YJ, Lee YS. Prognostic accuracy of the sequential organ failure assessment (SOFA) and quick SOFA for mortality in cancer patients with sepsis defined by systemic inflammatory response syndrome (SIRS). *Support Care Cancer*. 2020 Feb;28(2):653-659. **DOI:** 10.1007/s00520-019-04869-z. Epub 2019 May 22. **PMID:** [31119460](#).