Original Article

Eurasian Journal of Critical Care

One-Year Diagnosis and Cost Analysis of Patients Admitted to Intensive Care Units from the Emergency Department

Karahaliloglu CU.[1], Ay D.[2], Al B.[1], Erim K.[1], Altay TS.[1], Torun E.[1]

1 Istanbul Medeniyet University, Prof. Dr. Suleyman Yalcin City Hospital, Department of Emergency Medicine, Istanbul, Turkiye
2 Teutoburger Wald Klinik, Herford, Germany

Abstract

Background: This study aimed to conduct a one-year diagnostic and cost analysis of patients admitted from the emergency department to intensive care units.

Methods: In this retrospective study, we analyzed demographic data, the intensive care units to which patients were admitted, months of admission, admission diagnoses, length of stay, costs associated with diagnoses, and one-year prognosis outcomes for patients admitted from the emergency department of Göztepe Prof. Dr. Süleyman Yalçın City Hospital to internal medicine and general ICUs from January 1, 2015, to December 31, 2015.

Results: The study included data from 90 patients, comprising 52 males (57.8%) and 38 females (42.2%). The average age of participants was 68.04 ± 18.44 years. Patients were mainly admitted to the ICU with diagnoses of pneumonia (22.2%) and congestive heart failure (15.6%), respectively. ICU admissions peaked in March (16%), followed by May (12%) and April (11%). A total of 89 patients (98.9%) were admitted to the Internal Medicine ICU. The highest costs were linked to patients diagnosed with pneumonia and anemia. The average cost of services provided for all diagnoses was 1,572.33 Euros. The average length of stay for each patient in the ICU was 11.26 days. The highest daily costs were observed in patients with myocardial infarction (MI), sepsis, and pneumonia. Among the patients, 45.6% died, while 52.2% were discharged.

Conclusion: In our study, most intensive care patients were male. Pneumonia was the most prevalent diagnosis, peaking in late winter and early spring. Patients suffering from pneumonia and anemia incurred the highest treatment costs. Sepsis and CHF contributed to the longest stays in intensive care. Our mortality rate was 45.6%, significantly higher among those diagnosed with pneumonia.

Keywords: Emergency Department, Diagnosis, Cost, Intensive Care Unit, Mortality

Introduction

Intensive care units are specialized areas where healthcare professionals provide multidisciplinary services for the diagnosis, management, and follow-up of critically ill or injured patients. Patients admitted to intensive care units face a significant risk of death in the hospital. For instance, mortality rates stand at 17% for patients with cardiac causes (1). Early intervention and prompt access to intensive care are linked to better survival outcomes (2). ICU admission rates vary significantly between countries, with these variations connected to patient severity (1), institutional resources (3), physician practices, and local protocols (4). Coordinating transportation to the intensive care unit, motivating healthcare professionals, and developing clinical guidelines can enhance the healthcare system's quality, equity, and efficiency. These factors are directly related to patient survival.

Several publications in the literature, including APACHE and SAPS, have examined and compared mortality prediction models for ICU patients that depend on expert panels or statistical models (5). These models and scoring systems are typically available 24 to 48 hours after admission. Predictions are based on information that is available early on (6). Cardiovascular diseases, respiratory diseases, multi-organ issues, nervous system disorders,

Corresponding author: Cihad Ünsal Karahaliloğlu
e-mail: cunsalk@hotmail.com
• **Received:** 16.02.2025 • **Revision:** 12.03.2025 • **Accepted:** 08.04.2025
DOI: 10.55994/ejcc.1638575

Cite this article as: Karahaliloglu CU, Ay D, Al B, Erim K, Altay TS, Torun E. One-Year Diagnosis and Cost Analysis of Patients Admitted to Intensive Care Units from the Emergency Department. Eurasian Journal of Critical Care. 2025;7(1): 7-12

ORCID:
Cihad Ünsal Karahaliloğlu: orcid.org/ 0000-0003-0445-3034
Didem Ay: orcid.org/ 0000-0002-0406-6440
Behçet Al: orcid.org/ 0000-0001-8743-8731
Kerim Erim: orcid.org/ 0000-0002-8383-7206
Turab Sami Altay: orcid.org/ 0000-0003-3931-4018
Eltaf Torun: orcid.org/ 0000-0003-1251-2065

cerebrovascular diseases, renal failure, advanced age, and electrolyte imbalances are the main factors that extend the length of stay in intensive care (7). It is essential to follow accepted evidence-based guidelines for admitting patients to intensive care units and discharging them home after treatment. This method effectively utilizes resources, potentially cuts costs, enhances patient comfort, and reduces prolonged hospitalizations and complications (8).

In this study, we aimed to retrospectively analyze the diagnoses, morbidity, mortality, and cost of patients admitted to the intensive care units from the Emergency Department of Göztepe Prof. Dr. Süleyman Yalçın City Hospital between January 1, 2015, and December 31, 2015.

Method

Objective: This study aimed to retrospectively analyze the one-year diagnoses and costs of patients admitted to internal medicine and general intensive care units (ICUs) from the emergency department of Göztepe Prof. Dr. Süleyman Yalçın City Hospital between January 1, 2015, and December 31, 2015. Ethical committee approval was obtained on May 31, 2016, and the Helsinki Declaration was used to conduct the study.

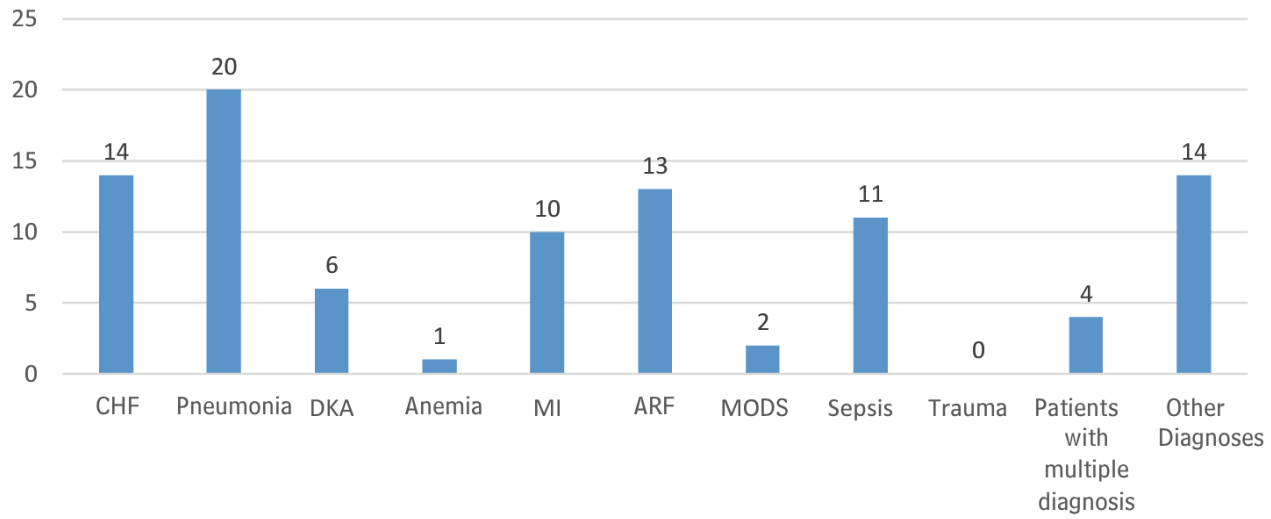
- **Data Collection**: Our hospital records all information using the Nucleus program. With the ethical committee's approval, the data required for this study were accessed through the Nucleus database.
- **Collected Data**: Patients' demographic information (age, gender), the ICUs admitted to, months of admission, admission diagnoses, length of stay, costs based on diagnoses, and prognosis.
- **Diagnosis Selection**: The main reason or predominant condition that led the patient to the emergency department was accepted as the diagnosis (in patients with multiple comorbidities, the primary condition resulting in ICU admission was considered the diagnosis).
- **Non-ICU Costs**: Dialysis costs were assessed by incorporating them into the unit's expenses associated with the dialysis procedure performed.
- **Inclusion Criteria**: Patients who are 18 years or older and have been admitted to ICUs from the emergency department.
- **Exclusion Criteria**: Patient files that contained incomplete data were excluded from the study.
- **Statistical Analysis**: Analyses were conducted using SPSS version 23.0 software. The variables' normality was evaluated visually (through histograms and probability plots) and analytically (using Kolmogorov-Smirnov and Shapiro-Wilk tests). Descriptive analyses were provided using means and standard deviations for normally distributed variables. The Pearson Chi-Square and Fisher's Exact Tests were applied to 2x2 tables. Mann-Whitney U tests were employed to compare the two groups for data that was not normally distributed. A p-value less than 0.05 was deemed statistically significant.

Results

The study included data from 90 patients, consisting of 52 males (57.8%) and 38 females (42.2%). The mean age of the participants was 68.04 ± 18.44 years, with a median age of 71.5 years. The most common diagnoses for ICU admission were pneumonia (22.2%, n=20) and congestive heart failure (CHF) (15.6%, n=14) (Table 1).

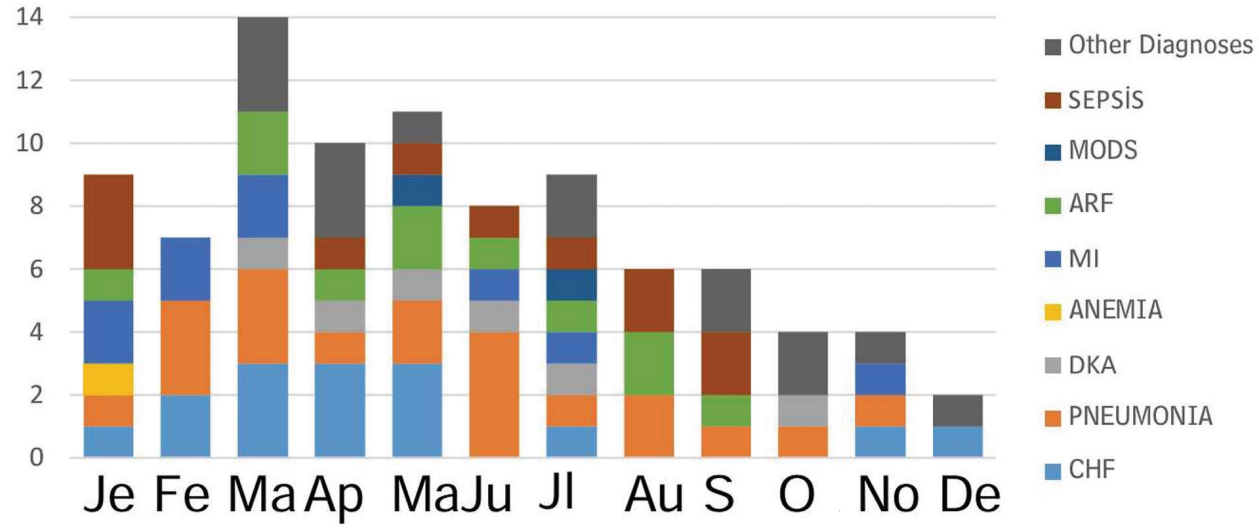
Admissions to emergency services and ICUs were most common at the end of winter and in spring. The highest

Table 1. Diagnoses leading to ICU admissions



CHF: Congestive Heart Failure, DKA: Diabetic Ketoacidosis, MI: Myocardial Infarction, ARF: Acute Renal Failure, MODS: Multiple Organ Dysfunction Syndrome

Table 2. Distribution of emergency department admissions by time and diagnosis



ARF: Acute Renal Failure, MI: Myocardial Infarction, DKA: Diabetic Ketoacidosis, CHF: Congestive Heart Failure, MODS: Multiple Organ Dysfunction Syndrome

ICU admissions occurred in March (16%), May (12%), and April (11%) (Table 2). Pneumonia admissions were spread throughout the year, while CHF admissions rose at the end of winter and early spring. Sepsis admissions peaked in the summer (Table 2). Among the patients, 89 (98.9%) were admitted to the Internal Medicine ICU, 2 (2.2%) to the Coronary ICU, and 3 (3.3%) to the General ICU. Four patients required ICU admission due to clinical conditions involving multiple diseases. Twenty-seven patients (30%) were treated solely in the ICU, while 63 (70%) received treatment in both the ICU and inpatient wards. Three patients, two diagnosed with sepsis and one with myocardial infarction (MI), required care in two different ICUs.

Cost Analysis: The costs during ICU stays included hemodialysis, blood transfusions, consultations, and medical treatments. Total expenses comprised both ICU services and the subsequent inpatient ward services. Patients with pneumonia and anemia incurred the highest costs in both ICU and total expenditures. The lowest average ICU expenditure was recorded in patients with diabetic ketoacidosis (DKA), while the lowest total spending was observed in patients with myocardial infarction (MI).

The average ICU cost for internal medicine patients was €6,299.54, while the average inpatient ward cost was €383.16. The average cost for all services provided across all diagnoses was €1,572.33. Patients spent an average of 11.26 days in the ICU, with a daily average cost of €624.52. No significant correlation was observed between the length of ICU stay and daily ICU costs ($p > 0.05$). Sepsis, CHF, and pneumonia had the longest average ICU stays (Table 5). The highest daily costs were linked to MI, sepsis, and pneumonia. Pneumonia was the most common admission diagnosis and ranked third in daily expenses (Table 5).

Mortality and Outcomes: ICU mortality rates encompassed patients who passed away after being transferred from the ICU to inpatient wards. Patients admitted to the ICU multiple times within a year were assessed separately for each admission, while readmissions during the same episode were regarded as a single admission.

A total of 41 patients (45.6%) died, 47 patients (52.2%) were discharged, and two patients (2.2%) were transferred to the ICU of another hospital. Pneumonia had the highest mortality rate. No deaths were reported among patients with DKA (5).

Table 3. Distribution of diagnoses by gender

Diagnoses	Male	Female	P
Congestive Heart Failure	9(17,3)	5(13,2)	0,592**
Pneumonia	11(21,2)	9(23,7)	0,775**
Diabetic Ketoacidosis	3(5,8)	3(7,9)	0,690*
Anemia	0(0,0)	1(2,6)	0,239*
Myocardial Infarction	5(9,6)	5(13,2)	0,597*
Acute Renal Failure	8(15,4)	5(13,2)	0,767**
Multiple Organ Dysfunction Syndrome	2(3,8)	0(0,0)	0,221*
Sepsis	6(11,5)	5(13,2)	0,817*
Patients with multiple diagnosis	2(3,8)	2(5,3)	0,747*
Other Diagnoses	10(19,2)	7(18,4)	0,923**

(Significance evaluated using Fisher's Exact Test or Chi-Square Test)

Discussion

The frequency of emergency department admissions in our country is increasing daily. Hospital patient admis-

Table 4. Costs by diagnoses (in ₺)

Diagnoses	Mean (₺)	±ss (₺)	Minimum (₺)	Maximum (₺)
CHF				
Intensive Care	5477,22	7261,07	117,27	21315,75
Total sum	6011,10	7074,39	326,56	21315,75
Pneumonia				
Intensive Care	14698,83	12674,94	173,09	37691,98
Total sum	16517,68	15228,94	60,00	58010,21
Diabetic Ketoacidosis				
Intensive Care	1669,10	1219,63	174,88	3741,70
Total sum	2251,68	2218,82	174,88	6558,02
Anemia				
Intensive Care	10980,61	0,0	10980,61	10980,61
Total sum	11755,69	0,0	11755,69	11755,69
Myocardial Infarction				
Intensive Care	1759,18	1458,89	587,66	5641,02
Total sum	2128,19	1461,28	1001,27	5665,76
Acute Renal Failure				
Intensive Care	5265,58	5038,18	390,55	16470,17
Total sum	7443,89	6291,27	857,96	21283,83
MODS				
Intensive Care	5895,27	1842,08	4592,72	7197,82
Total sum	6153,80	1951,49	4773,89	7533,71
Sepsis				
Intensive Care	5946,50	5983,28	955,98	20223,66
Total sum	7709,16	5453,54	2298,42	20223,66
Other Diagnoses				
Intensive Care	3542,34	2815,96	459,36	9335,72
Total sum	3899,85	2972,72	459,36	9335,72
Patients with multiple diagnosis				
Intensive Care	1750,54	1938,72	173,09	4491,42
Total sum	3718,72	1738,34	1490,35	5672,76

sions are rapidly growing alongside population growth. In 2023, Turkey's population was 85,372,377 individuals, 50.1% male and 49.9% female (9). According to data from the Ministry of Health of the Republic of Turkey for 2022, there are 1,555 hospitals, 264,969 hospital beds, and 48,617 intensive care unit beds (10). The number of physicians per 100,000 population is 228.

The acceptance of walk-in patients and the rise in ambulance entries have increased the workload of emergency services and their supporting units. This increasing workload has become more challenging to identify and manage critically ill patients. We strive to overcome this challenge by actively utilizing an appropriate triage system. For emergency department staff, understanding the impact of chronic diseases on prognosis in critical patients, the cost implications of patients on the social security system, and the seasonal characteristics of patient admission frequencies can assist in proper workforce planning and the development of an effective cost-strategy for emergency services and supporting inpatient units.

The number and quality of intensive care units responsible for the care of critical patients following emergency department management are increasing every day. However, this increase does not meet the admission rates of patients requiring intensive care; thus, the challenges persist. Given the high cost of utilization, need, and limited availability, the rational use of intensive care beds is essential. According to the Turkish Statistical Institute (TÜİK) data, the occupancy rate of adult intensive care beds was approximately 80% in 2015, 83% in January 2024, and around 71% in February 2024 (Ministry of Health Press Bulletin). These rates are even higher in densely populated metropolitan areas. During times of increased viral infections, particularly in winter, many patients with indications for intensive care often wait hours or even days in emergency departments for an available bed. These delays sometimes cause interruptions in treatment.

A study by Shih, Chia, and colleagues showed that the mortality rate of patients on mechanical ventilation awaiting an intensive care bed in the emergency department increases after four hours (11).

The patient population in our study was middle-aged (68.04 ± 18.44 years), with most males (57.8%). Similarly, Shih, Chia, and colleagues' study of 1,242 patients

Table 5. Distribution of diagnoses, ICU length of stay, daily costs, and mortality rates

Diagnosis	Length of stay in the ICU Average (ss)	Daily Cost Average(ss)	Exitus	In terms of mortality P
Congestive Heart Failure	14,86 (16,09)	427,81(200,55)	7(50,0)	0,716**
Pneumonia	12,10 (15,33)	726,96(631,15)	12(60,0)	0,141**
Diabetic Ketoacidosis	6,83(3,66)	461,80(305,12)	0(0,0)	0,020*
Anemia	1,00(0,0)	173,09(0,0)	1(100,0)	0,272*
Myocardial Infarction	6,10(5,97)	795,64(557,29)	5(50,0)	0,765**
Acute Renal Failure	11,23(7,81)	579,09(497,52)	4(30,8)	0,247**
MODS	6,50(6,36)	438,32(138,83)	1(50,0)	0,898*
Sepsis	17,00(14,91)	739,29(593,57)	7(63,6)	0,199*
Patients with Multiple Diagnosis	7,00(5,10)	330,14(29,65)	3(75,0)	0,226*
Other Diagnosis	9,12(8,53)	562,12(391,65)	7(41,2)	0,687**

Diagnosis | ICU Stay (Mean ± SD, days) | Daily Cost (Mean ± SD, Euros) | Mortality (%) | p-value

reported a mean age of 67.0 ± 15.4 years and a male ratio of 60.1%, which aligns with our findings (11).

The primary reason for higher admissions in winter is the rise in viral infections during this time, significantly affecting individuals with comorbid conditions. A study by Sert, Mutlu, and colleagues involving 2,254 patients revealed that emergency department admissions peaked in March 2015 (9.48%) and in January 2016 and 2017 (11.07% and 9.44%, respectively), aligning with the increased winter admissions observed in our study. (12) The rise in viral infections also accounts for higher pneumonia diagnoses and increased admissions to intensive care units. In the same five-year study, respiratory diseases accounted for the highest emergency department admissions at 24.71% (12).

Most patients requiring intensive care had an internal cause. A study by Chin-Yee and colleagues reported that 62% of patients were admitted to intensive care units for internal pathologies and 25% for surgical emergencies (13). The absence of trauma-related intensive care admissions in our study can be attributed to the low number of trauma cases presented to our emergency department. Additionally, coronary intensive care units at our hospital did not manage patients requiring mechanical ventilation during the study period, and coronary angiography was not performed after 9:00 PM due to equipment and personnel constraints, resulting in fewer coronary intensive care patients.

In four patients, clinical conditions requiring intensive care were associated with more than one disease, with pneumonia also present in three of these patients in addition to their primary diagnosis. Advanced age and immunosuppression increase the risk of community-acquired pneumonia, while dental care and a high socioeconomic status reduce it. Community-acquired pneumonia remains a major driver of healthcare costs worldwide. In our study, the mean age of patients was 68 years, and approximately half had a diagnosed chronic condition. Patients diagnosed with pneumonia accounted for highly intensive care admission and treatment costs. Chin-Yee and colleagues' study with 1,671 patients found that respiratory diseases were the most common reason for intensive care admissions (26%), followed by cardiovascular diseases (23%), aligning with our findings, where pneumonia was the most common and congestive heart failure (13). The high cost associated with these patients stems from prolonged hospital stays. The lowest costs were observed in diabetic ketoacidosis (DKA) patients due to their rapid response to treatment and early discharge.

Decompensated congestive heart failure was the second most common diagnosis, leading to admission to intensive care from the emergency department. According to the "Heart Failure Prevalence and Predictors in Turkey (HAPPY) study," the prevalence of heart failure was reported at 2.9%. Effective management of heart failure can lower hospital admissions, mortality, morbidity, and associated costs (14). In our study, congestive heart failure was identified as the most common comorbid condition, observed in 15.6% of cases.

The group with the most extended average length of stay in intensive care consisted of patients diagnosed with sepsis. We believe this is due to a delayed response to treatment. At our hospital, patients admitted to intensive care from the emergency department had an average length of stay of 11.26 days, with a daily cost averaging €624.52. In a study by Toptas and colleagues involving 3,925 patients, the average length of stay in intensive care was 10.2 days (15). A review by Chacko and colleagues of cost studies from countries such as India, the United States, Germany, France, and Australia revealed that daily intensive care costs ranged from €200 to €4,300, with labor costs and length of stay being the primary drivers of these differences (16).

In terms of daily costs based on diagnoses, myocardial infarction, sepsis, and pneumonia were associated with the highest daily costs in our study. As noted above, pneumonia was the most common diagnosis in our study. Early detection and treatment of uncomplicated pneumonia cases could prevent intensive care admissions, leading to lower morbidity, mortality, and healthcare costs. Improving primary care services could facilitate the early detection and management of diseases such as pneumonia and congestive heart failure, either in outpatient settings or inpatient wards, reducing the workload of emergency services and intensive care units and mortality rates and associated costs for social security systems.

Establishing and expanding palliative care centers could help elderly patients with chronic conditions receive proper follow-up and care, potentially reducing their frequency of emergency department visits.

Approximately 45.6% of our patients died. Çakır and colleagues reported a lower intensive care unit mortality rate of 34.7% in a study with 757 patients (17). Similarly, Şahin and colleagues' study involving 300 patients reported an emergency-to-intensive care unit mortality rate of 38.7%, which was also lower than our study's (18). Although not statistically significant, patients with pneumonia, sepsis, or multiple diagnoses had higher mortality rates.

Limitations: We consider the study's limitations to be its retrospective nature, its conduct in a single center with a relatively small number of patients, and its inability to follow up with patients referred to external centers.

Conclusion: In our study, most intensive care patients were male. Pneumonia was the most prevalent diagnosis, peaking in late winter and early spring. Patients with pneumonia and anemia faced the highest treatment costs. Sepsis and CHF led to the most extended stays in intensive care. Our mortality rate was 45.6%, notably higher among patients diagnosed with pneumonia.

References

1. Chioncel O, Mebazaa A. Characteristics of intensive care in patients hospitalized for heart failure in Europe. Heart Fail Clin 2015;11:647–56.
2. Epstein AJ, Polsky D, Yang F, et al. Geographic variation in implantable cardioverter-defibrillator use and heart failure survival. Med Care 2012;50:10.
3. Adhikari NK, Fowler RA, Bhagwanjee S, et al. Critical care and the global burden of critical illness in adults. Lancet 2010;376:1339–46.
4. Dondo T, Hall M, Timmis A, et al. Geographic variation in non-ST-segment myocardial infarction treatment in the English National Health Service: a cohort study. BMJ Open 2016;6:e011600.
5. Knaus WA, Draper EA, Wagner DP, et al. APACHE II: a severity of disease classification system. Crit Care Med 1985; 13(10): 818–829.
6. Awad A, Bader A Den M, Al Sonbath Y et al. Predicting hospital mortality for intensive care unit patients: Time-series analysis. Health Informatics J. 2020; 26(2):1043-1059.doi: 10.1177/1460458219850323.https://doi.org/10.1177/146045821985032.
7. Topbaş M, Samanci NS, Akkoç İ, et al. Factors Affecting the Length of Stay in the Intensive Care Unit: Our Clinical Experience. Biomed Res Int. 2018, 20:2018:9438046. Doi: 10.1155/2018/9438046.
8. Hassan EM, Jama AB, Sharaf A, et al. Discharging patients home from the intensive care unit: A new trend. World J Clin Cases.2024 Aug 16;12(23):5313-5319. doi: 10.12998/wjcc.v12.i23.5313.
9. https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2023-49684
10. https://dosyasb.saglik.gov.tr/Eklenti/48054/0/siy202205042024pdf.pdf
11. Hung, SC., Kung, CT., Hung, CW. et al. Determining delayed admission to the intensive care unit for mechanically ventilated patients in the emergency department. Crit Care 18, 485 (2014). https://doi.org/10.1186/s13054-014-0485-1
12. Sert ET, Mutlu H, Kokulu K, Yeşildağ K, Sarıtaş A. Acil Servisimize Başvuran Hastaların 5 Yıllık Analizi, Medical Jurnal of Muğla, Year 2021, Volume:8, Issue:1,1-4, 30/04/2021, https://doi.org/10.47572/muskutd.794039
13. Chin-Yee, N., D'Egidio, G., Thavorn, K. Et al. Cost analysis of the very elderly admitted to intensive care units. Crit Care 21, 109 (2017). https://doi.org/10.1186/s13054-017-1689-y
14. 2023 Focused Update of the 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure
15. Toptas, Mehmet, Sengul Samanci et al. Factors Affecting the Length of Stay in the Intensive Care Unit: Our Clinical Experience, BioMed Research International, 2018, 9438046, 4 pages, 2018. https://doi.org/10.1155/2018/9438046
16. Chacko B, Ramakrishnan N, Peter JV. An approach to Intensive Care Costing and the Provision of Cost-effective Care. Indian J Crit Care Med 2023;27(12):876–887.
17. Çakır Esra, Kocabeyoğlu Gül Meral, Yoğun Bakım Ünitesinde Mortalite Sıklığı ve Rişsk Faktörlerinin Değerlendirilmesi, Anakara Eğt. Arş. Hast. Derg. (Med. J. Ankara Tr. Res. Hosp.), 2020; 53(1): 20-24
18. Şahin O, Kucuk M, Küçükgüçlü S. Acil Servisten Anestezi Yoğun Bakım Ünitesi'ne Kritik Hasta Yatışlarının Değerlendirilmesi. DEU Tıp Derg. 2023;37(2):161-7.