ORIGINAL ARTICLE

DOI: 10.4274/nkmj.galenos.2023.87004
Nam Kem Med J 2023;11(2):87-93

Prolonged Stay in the Intensive Care Unit: A Retrospective Analysis of Six Years

Yoğun Bakım Ünitesinde Uzamış Yatış: Altı Yılın Retrospektif Analizi

Onur BARAN, Ayhan ŞAHİN, Ahmet GÜLTEKİN, Cavidan ARAR

Tekirdağ Namık Kemal University Faculty of Medicine, Department of Anesthesiology and Reanimation, Tekirdağ, Turkey

ABSTRACT

Aim: A prolonged intensive care unit stay (ICU) is associated with many factors and causes various problems. This study aims to evaluate the clinical characteristics and the factors that led to the stay of the patients treated in the ICUs for 30 days and more.

Materials and Methods: The data of 178 patients were analyzed retrospectively. Those with an ICU stay of 7-29 days (n=89) were assigned as "ICU stay day <30 days - Group 1" and those with a stay of 30 days and more (n=89) were assigned as "ICU stay day ≥30 days - Group 2". The factors related to a prolonged ICU stay were investigated in this study. The data obtained from the hospital data system were compared.

Results: The age and gender distributions of the 178 patients were not statistically different between the two groups (p=0.355 and p=0.758, respectively). The group with an ICU stay of ≥30 days had a significantly higher tracheostomy rate (p<0.05) than the group with an ICU stay of <30 days. In this study, percutaneous endoscopic gastrostomy procedures were used more frequently on patients who stayed in the ICU for 30 days or more than on those who stayed for less than 30 days (p=0.000).

Conclusion: Prolonged ICU stay are caused by multiple factors, and palliative care units and home care facilities must be used frequently to make the best use of ICU beds and to prevent prolonged ICU stays, which cause increased mortality and negative financial outcomes.

Keywords: Prolonged stay, intensive care unit, critically ill

ÖZ

Amaç: Yoğun bakım ünitesinde (YBÜ) uzamış yatış birçok faktörle ilişkilidir ve çeşitli sorunlara neden olur. Bu çalışma, 30 günden fazla YBÜ'de tedavi gören hastaların klinik özelliklerini değerlendirmeyi amaçlamaktadır.

Gereç ve Yöntem: Yüz yetmiş sekiz hastanın verileri retrospektif olarak incelendi. YBÜ'de 7-30 gün yatış süresi olanlar "YBÜ yatış günü <30 gün - Grup 1", 30 gün ve üzeri yatış süresi olanlar ise "YBÜ yatış günü ≥30 gün - Grup 2" olarak tanımlandı. Bu çalışmada YBÜ'de yatış süresinin uzamasına neden olan faktörler araştırıldı. Hastane veri sisteminden elde edilen veriler karşılaştırıldı.

Bulgular: Yüz yetmiş sekiz hastanın yaş ve cinsiyet dağılımları iki grup arasında istatistiksel olarak farklı değildi (sırasıyla; p=0,355 ve p=0,758). YBÜ'de ≥30 gün kalan grupta trakeostomi oranı <30 gün YBÜ'de kalan gruba göre anlamlı olarak daha yüksekti (p<0,05). Bu çalışmada 30 gün ve üzeri YBÜ'de kalan hastalarda 30 günden az kalanlara göre daha sık perkütan endoskopik gastrostomi işlemi uygulandı (p=0,000).

Sonuç: Uzun süreli yoğun bakım yatışlarına birden fazla faktör neden olmaktadır. Yoğun bakım yataklarından en iyi şekilde yararlanmak ve mortalite artışına ve olumsuz finansal sonuçlara neden olan uzun süreli yoğun bakım yatışlarını önlemek için palyatif bakım üniteleri ve evde bakım tesislerinin sık kullanılması gerekmektedir.

Anahtar Kelimeler: Uzun süreli yatış, yoğun bakım ünitesi, kritik hasta

Address for Correspondence: Onur BARAN MD, Tekirdağ Namık Kemal University Faculty of Medicine, Department of Anesthesiology and Reanimation, Tekirdağ, Turkey
Phone: +90 539 342 25 82 **E-mail:** obaran@nku.edu.tr **ORCID ID:** orcid.org/0000-0003-0007-6315
Received: 16.12.2022 **Accepted**: 15.02.2023

INTRODUCTION

The care of critically ill patients requires a significant amount of time, resources, and money as well as specialist staff, nursing care, and equipment[1,2].

Although some critically ill patients are discharged early from intensive care units (ICUs), others require a prolonged ICU stay, which causes complications such as muscle weakness, pressure ulcers, infections, pulmonary embolism, and delirium. Additionally, a prolonged ICU stay is associated with high hospital-related morbidity and mortality rates and negative long-term consequences[3-7]. Critically ill patients with a prolonged ICU stay typically require more time and medical resources than usual[4]. It may be impossible to achieve acceptable mortality rates and quality of life despite the high costs invested in medical care associated with prolonged ICU stays[8-10].

The precise definition of a prolonged ICU stay varies in the literature, as several studies have used different stay limits, such as >7, 14, 21, 29, or 30 days[11-18]. The APACHE-II score, the SOFA score, the need for mechanical ventilation, the need for vasopressors, and multiple organ failure have been identified as the factors that contribute to a prolonged ICU stay[15,18-20].

In this study, we aimed to determine the clinical characteristics of patients who were treated in ICUs for 30 days or more and to determine the factors that affected the prolonged duration of their stay.

MATERIALS AND METHODS

Ethical approval of this study was obtained from Tekirdağ Namık Kemal University Non-Interventional Research Ethics Committee (protocol no: 2022.191.10.15, date: 25.10.2022).

In our hospital, there are two 11-bed tertiary ICUs controlled by the department of anesthesiology and reanimation. These ICUs accept surgical and nonsurgical patients and have anesthesiologists available around the clock. There are also other ICUs controlled by other departments such as internal medicine, cardiology, cardiovascular surgery, neurology, and pediatric diseases.

A six-year retrospective study was conducted after receiving approval from the local ethical committee. From May 2017 to September 2022, scans and data collection were performed on 2811 patients who were being monitored in the 11-bed tertiary ICU, which accept patients from the operating theater, wards, emergency services, and outlying center hospitals.

The hospital data system was scanned retrospectively, and 89 patients who spent 30 days or more in the ICU between May 2017 and September 2022 were identified. Additionally, the files of 89 patients who spent between 7 and 30 days in the ICU were randomly scanned and selected from the hospital data system. In other words, this study included 178 patients divided into two groups: Group 1 for ICU stay <30 days and Group 2 for ICU stay ≥30 days. All the data were obtained from the administration registry book of the ICU, hospital electronic patient data system, and patient charts.

This study was conducted according to the ethical principles outlined in the Helsinki Declaration and the guidelines of good clinical practice.

Statistical Analysis

The mean, standard deviation, median, minimum, maximum, frequency, and ratio values were used for the descriptive statistics of the data. The Kolmogorov-Smirnov test was used to measure the distribution of the variables. The Independent Sample t-test and the Mann-Whitney U test were employed to analyze the quantitative independent data. A chi-square test was used to analyze the qualitative independent data, and Fisher's test was used when the chi-square test conditions were not met. Statistical analysis was carried out with the Statistical Package for the Social Sciences 28.0 software.

RESULTS

The patients had a median age of 66 years, with a mean age of 64.8±15.8 years. The patients comprised of 38.8% females and 61.2% males. Group 1 had a mean age of 65.6 years while Group 2 had a mean age of 64 years. Group 1 consisted of 33 female (37.1%) and 56 male (62.9%) patients, Group 2 consisted of 36 female (40.4%) and 53 male (59.6%) patients (Table 1). The age and gender distributions of the patients were not statistically different between the two groups (p=0.355; p=0.758) (Table 1). About 37.1% and 41.6% of the patients with ICU stays of <30 days and ≥30 days, respectively, were accepted from emergency services. Patients accepted from outlying hospitals had the second-highest population. The admission diagnoses of both groups were respiratory failure following CPR and chronic obstructive pulmonary disease, respectively. The three main admission sources and admission diagnoses did not differ between the groups (p>0.05).

Tracheostomy was performed on 28.1% (n=50) of the patients during their ICU stay (Table 1). Additionally, percutaneous endoscopic gastrostomy (PEG) was performed on patients who were unable to eat orally or who were predicted to require tube-feeding for a long time. About 11.8% (n=21) of the patients underwent PEG procedure (Table 1). Furthermore, 32% (n=57) of the patients required vasopressors, 92.7% (n=165) were on mechanical ventilation upon admission, and 28.1% (n=50) were admitted to the ICU after surgery (Table 1).

Group 2 had a significantly higher tracheostomy rate (p<0.05) than Group 1 (Table 1). Group 2 had a significantly longer

tracheostomy opening day and a longer number of days from tracheostomy opening until discharge (p<0.05) than Group 1. Group 2 had a significantly higher PEG ratio (p<0.05) than Group 1 (Table 1). Both groups had no significant differences in the day of PEG opening and the number of days from PEG opening until discharge from the ICU (p>0.05; Table 1).

Group 2 had a considerably lower need for inotropic drugs at admission (p<0.05) than Group 1 (Table 1). Additionally, Group 2 had a considerably longer inotrope intake time (p<0.05) than Group 1. The rate of receiving mechanical ventilation support did not differ significantly (p>0.05) between both groups. Group 2 had a significantly longer mechanical ventilation time (p<0.05) than Group 1. Additionally, Group 2 received a significantly higher amount of transfused ES and FFP (p<0.05) than Group 1. The postoperative admission rate and the dialysis history rate did not differ significantly (p>0.05) between both groups (Table 1).

The APACHE-II scores for predicting the mortality rate did not differ significantly (p>0.05) between the groups. Group 1 had a significantly higher exitus rate (p<0.05) than Group 2 (Table 2).

The sodium, potassium, chloride, magnesium, blood urea nitrogen, creatinine, alanine aminotransferase, aspartate aminotransferase, lactate, and C-reactive protein values at admission did not differ significantly (p>0.05) between the

Table 1. Demographic and clinical characteristics of the patients

		ICU stay day <30 days Group 1				ICU stay day ≥30 days Group 2				p	
		Mean±SD/n-%			Median	Mean±SD/n-%			Median		
Age		65.6	±	16.4	67.0	64.0	±	15.2	65.0	0.355	m
Sex	Female	33		37.1%		36		40.4%		0.758	X^2
	Male	56		62.9%		53		59.6%			
Tracheostomy	N/A	82		92.1%		46		51.7%		**0.000**	X^2
	(+)	7		7.9%		43		48.3%			
Tracheostomy											
Tracheostomy opening day		6.3	±	6.8	8.0	23.3	±	14.9	21.0	**0.001**	m
Tracheostomized day		8.6	±	3.5	10.0	37.2	±	29.3	28.0	**0.001**	m
PEG	N/A	88		98.9%		69		77.5%		**0.000**	X^2
	(+)	1		1.1%		20		22.5%			
PEG											
PEG opening day		0.0	±		0.0	34.8	±	19.8	32.5	0.102	t
How many days since PEG opening		10.0	±		10.0	33.9	±	30.0	24.0	0.447	t
Vasopressor drug need in admission	N/A	52		58.4%		69		77.5%		**0.006**	X^2
	(+)	37		41.6%		20		22.5%			
Vasopressor drug need (days)		5.2	±	5.7	4.0	9.6	±	10.4	6.0	**0.004**	m
Need for mechanical ventilation	N/A	9		10.1%		4		4.5%		0.150	X^2
	(+)	80		89.9%		85		95.5%			
Mechanical ventilation day (days)		9.2	±	6.0	8.0	32.3	±	21.4	31.0	**0.000**	m
Transfused erythrocyte suspension (units)		1.6	±	2.6	0.0	6.0	±	7.3	3.0	**0.000**	m
Transfused fresh frozen plasma (units)		3.5	±	4.8	2.0	8.0	±	9.8	5.0	**0.000**	m
Admission after surgery	N/A	68		76.4%		60		67.4%		0.182	X^2
	(+)	21		23.6%		29		32.6%			
Renal replacement therapy	N/A	72		80.9%		69		77.5%		0.579	X^2
	(+)	17		19.1%		20		22.5%			
APACHE-II score		21.0	±	8.5	21.0	23.3	±	8.1	22.0	0.097	m
Predicted mortality rate		39.0	±	23.8	35.5	46.0	±	25.9	42.4	0.088	m
ICU stay day (days)		13.4	±	5.7	12.0	52.1	±	23.0	45.0		
Exitus	N/A	45		50.6%		29		32.6%		**0.015**	X^2
	(+)	44		49.4%		60		67.4%			

t: Independent sample t-test, m: Mann-Whitney U test, X^2: Chi-square test.

SD: Standard deviation, PEG: Percutaneous endoscopic gastrostomy, ICU: Intensive care unit

groups (Table 3). Group 2 had significantly higher calcium and albumin levels ($p<0.05$) than Group 1 (Table 3).

DISCUSSION

Advanced life support, mechanic ventilation, and organ support systems lengthen ICU stays for critically ill patients[21]. This six-year retrospective study aimed to determine the predisposing factors contributing to prolonged ICU stays. We selected a maximum stay limit of 30 days after conducting a literature search. We searched the hospital data system to determine if prolonged ICU stays were influenced by basic laboratory parameters, the need for vasopressors and mechanical ventilation upon admission, the need for tracheostomy and PEG, and related data, such as tracheostomy opening day, the number of tracheostomy days, PEG opening day, the number of days after PEG opening, transfused erythrocyte and fresh frozen plasma units, and renal replacement therapy during intensive care.

The description of a prolonged ICU stay in the literature varies between 7, 14, 30, and 90 days. For example, Miniksar and Keten[22] conducted a retrospective analysis and discovered that 3.11% of patients stayed in ICUs for more than 90 days. Alkali et al.[20] set a 14-day maximum limit for prolonged ICU stays and discovered that 401 (40.34%) out of 994 admitted patients had prolonged stays. In another study, it was discovered that 6% of 3257 patients stayed for 14 days or more in the ICU[23]. There are also studies that set a limit of 30 days or more for prolonged ICU stays and discovered that 1.6% and 4.92% of the patients stayed in the ICU for those periods, respectively[24,25]. In this study, we discovered that 89 patients (3.16%) out of 2811 patients stayed in the ICU for more than 30 days.

In this study, the age and gender distributions of the patients were not statistically different between the two groups. Çevik and Geyik[17] performed a retrospective study and reported that two groups with ICU stays of less than and more than 30 days had a statistically significant difference in age but not in gender. In another retrospective study, it was reported that there was a statistically significant difference in mean age

Table 2. Discharge status of the patients

	ICU stay day <30 days Group 1		ICU stay day ≥30 days Group 2		p	
	n	%	n	%		
Discharge status						
Exitus	44	49.4%	60	67.4%	**0.015**	x^2
Transfer to outer center	0	0.0%	2	2.2%	0.497	x^2
Transfer to ward	32	36.0%	18	20.2%	**0.020**	x^2
Transfer to home	8	9.0%	6	6.7%	0.578	x^2
Transfer to other ICU	5	5.6%	3	3.4%	0.469	x^2

x^2: Chi-square test, ICU: Intensive care unit

Table 3. Biochemical parameters of the patients

	ICU stay day <30 days Group 1				ICU stay day ≥30 days Group 2				p	
	Mean±SD/n-%			Median	Mean±SD/n-%			Median		
Sodium (mmol/L)	138.2	±	7.3	139.0	139.7	±	6.1	139.0	0.313	m
Potassium (mmol/L)	4.3	±	0.8	4.2	4.2	±	0.7	4.1	0.687	m
Calcium (mg/dL)	8.3	±	1.6	8.2	8.4	±	0.8	8.4	**0.048**	m
Chloride (mmol/L)	99.9	±	12.8	102.0	101.2	±	6.8	100.9	0.598	m
Magnesium (mg/dL)	2.0	±	0.4	2.0	2.0	±	0.4	1.9	0.814	m
Albumin (g/dL)	2.9	±	0.6	2.9	3.1	±	0.7	3.1	**0.020**	t
Blood urea nitrogen (mg/dL)	34.1	±	30.1	25.7	33.3	±	25.8	24.3	0.943	m
Creatinine (mg/dL)	1.4	±	1.2	1.0	1.6	±	1.7	1.1	0.669	m
Alanine aminotransferase (IU/L)	73.9	±	253.9	20.6	100.7	±	337.0	17.0	0.520	m
Aspartate aminotransferase (IU/L)	124.1	±	459.0	33.0	124.0	±	321.4	29.0	0.860	m
Lactate (mmol/L)	2.6	±	2.5	1.6	2.7	±	2.6	1.7	0.686	m
C-reactive protein (mg/L)	105.8	±	99.3	65.5	108.6	±	118.5	68.2	0.752	m

t: Independent Sample t-test, m: Mann-Whitney U test, x^2: Chi-square test.

SD: Standard deviation, PEG: Percutaneous endoscopic gastrostomy, ICU: Intensive care unit

between groups with prolonged ICU stays of more than 14 days; however, Arabi et al.[19] reported no significant difference in mean age and gender between groups of patients who stayed in the ICU for less than and more than 7 days[21].

Prolonged mechanical ventilation requirements and unsuccessful weaning are the major indications for tracheostomy[26]. Several studies have reported that tracheostomized patients require a prolonged ICU stay[17,19,22,27]. This study also demonstrated that the tracheostomized patients stayed in the ICU for relatively long periods. An early or late tracheostomy time may be considered when managing the airway during intensive care. Patients who stayed in the ICU for less than 30 days had a mean tracheostomy opening time of 6.3±6.8 days, while patients who stayed in the ICU for more than 30 days had a mean tracheostomy opening time of 22.3±14.9 days. The patients with an ICU stay of more than 30 days had considerably long tracheostomy opening days, which may have contributed to their prolonged ICU stay.

From another viewpoint, more patients were recommended for tracheostomies as their length of stay increased. Even though the group with an ICU stay of ≥30 days had a relatively high number of days from tracheostomy to discharge (i.e., transfer to another unit or death), patient survival or the absence of a need for an ICU stay depends on several other parameters. Miniksar and Keten[22] claimed that tracheostomized patients had much longer ICU stays. Similarly, Çevik and Geyik[17] reported that tracheostomy procedures were a predictor of prolonged ICU stays and mortality. In this study, we did not find tracheostomy to be a predictor of prolonged ICU stays or mortality.

Malnutrition risks, nosocomial infections, and multiple organ failure are the complications that extend the ICU stay of patients with already prolonged stays[28]. PEG is usually used for patients who require long-term enteral nutrition because of inadequate oral intake. PEG tubes are much more comfortable for feeding and provide higher nutritional efficacy than nasogastric tubes[29]. In this study, PEG procedures were used more frequently on patients who stayed in the ICU for more than 30 days than on those who stayed for less than 30 days. We believe that this occurred because a PEG procedure was indicated for patients who were expected to have a prolonged ICU stay and required long-term enteral nutrition owing to inadequate oral intake.

Patients with hypotension or septic shock require vasopressors or inotropes for normotension upon admission to ensure adequate organ perfusion. Severe hypotension or septic shock is associated with increased mortality[30]. Previous studies have demonstrated that patients who require inotropes or vasopressors have prolonged ICU stays[17,19]. Contrarily, we discovered that more patients with ICU stays of <30 days required these drugs upon admission than those with ICU stays of ≥30 days. This finding may be because patients who require vasopressors or inotropes upon admission have a decreased survival rate.

Most patients require mechanical ventilation upon admission or during intensive care[31]. Zampieri et al.[15] discovered that patients who required mechanical ventilation during intensive care needed to remain in the ICU for more than 14 days. Other studies in the literature have shown that the need for mechanical ventilation is effective in prolonging ICU stay[19,32]. In this study, 92.7% of the patients required mechanical ventilation regardless of how long they stayed in the ICU. There was no significant difference in mechanical ventilation requirements between the two groups. The mechanical ventilation duration is an important parameter because as it increases, mechanical ventilation-related complications, such as ventilator-related pneumonia and barotrauma, occur[33]. In this study, the patients who stayed in the ICU for more than 30 days had longer mechanical ventilation days. This may be explained by the fact that an increase in a patient's mechanical ventilation days causes additional complications and makes patient discharge challenging.

Blood transfusions are associated with increased morbidity, increased mortality, and complications such as prolonged ICU stays, increased mechanical ventilation requirements, and even multiple organ failure. Health care costs have increased, and patients who require intensive care are unable to receive it because there are not enough beds available[21,34,35]. Tobi and Amadasun[36], Halawi et al.[37], and Lipschitz[38] reported that a prolonged ICU stay was a predisposing factor for blood transfusions. Similarly, in this study, elderly patients and those with prolonged ICU stays received significantly more transfusions than patients with ICU stays of <30 days.

In this study, the two groups had no significant differences in admission after surgery, renal replacement therapy, APACHE-II scores, or predicted mortality rates. In a Japanese multicenter retrospective cohort study, patients with prolonged ICU stays had a significantly higher APACHE-II score of 23 than those with short ICU stays (APACHE-II score: 13)[39]. Various studies have also discovered a relationship between high APACHE-II scores and prolonged ICU stays[18,40,41]. However, Kıray et al.[21] observed no differences in terms of APACHE-II scores between patients with prolonged and short ICU stays. Santana Cabrera et al.[25] discovered that patients with surgical admission had prolonged stays, but Toptas et al.[42] reported that patients with no surgical admission had prolonged ICU stays. Çevik and Geyik[17] stated that renal replacement therapy did not affect the length of stay, but Santana Cabrera et al.[25] stated that patients who received renal replacement therapy for long periods had long ICU stays. According to the literature, renal

replacement therapy may prolong ICU stay because it prevents acute complications associated with acute renal failure[43,44].

Although we discovered that the two groups had no difference in APACHE-II scores, the group with a prolonged ICU stay had a significantly higher mortality rate than the group with a short ICU stay. This result may be due to several factors, such as the opinion that critically ill patients who require high doses of vasopressors and are unresponsive to conventional treatments may not survive for a long time and may therefore stay in the ICU for less than 30 days. However, even if the patient's status is quite stable at the time of admission, other factors, such as unsuccessful weaning, the need for prolonged mechanical ventilation, the reluctance of patient's relatives to provide their consent for procedures such as tracheostomies and PEGs, the reluctance to transport tracheostomized patients home with home ventilators, and the unavailability of ward and palliative beds to discharge the patient, may make the patient vulnerable to other complications such as nosocomial infections, ventilator-associated pneumonia, and increased mortality. There are also similar opinions in the literature[15].

Electrolyte imbalance is a common problem in critically ill patients upon admission[45]. In this study, despite investigating the electrolyte, renal, and hepatic parameters at the time of admission, we could not find a relationship between basic laboratory parameters and a prolonged ICU stay, except for calcium and albumin levels. This is because the length of ICU stays increases as the calcium and albumin levels increase. Toptas et al.[42] discovered that patients' length of ICU stay increases when their urea, creatinine, and sodium levels increase. Miniksar and Keten[22] also reported that hypomagnesemia was significantly related to a prolonged ICU stay.

Study Limitations

In this single-center study, our case number was low compared to similar studies in the literature. The deficiencies in various scoring systems and their records in the hospital information system from past to present have been one of the limiting steps of our study.

CONCLUSION

In this six-year retrospective study, we aimed to determine the predictors of prolonged ICU stays. We discovered that patients who stayed in the ICU for more than 30 days had a relatively high mortality rate. Additionally, tracheostomy and PEG procedures were found to be related to prolonged ICU stays in our study. The absence of a need for vasopressors was also found to be associated with prolonged ICU stays. Prolonged ICU stays are caused by multiple factors, and palliative care units and home care facilities must be used frequently to make the best use of ICU beds and prevent prolonged ICU stays, which cause increased mortality and negative financial outcomes.

Ethics

Ethics Committee Approval: Ethical approval of this study was obtained from Tekirdağ Namık Kemal University Non-Interventional Research Ethics Committee (protocol no: 2022.191.10.15, date: 25.10.2022).

Informed Consent: Retrospective study.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: O.B., Concept: O.B., Design: O.B., Data Collection or Processing: O.B., A.G., Analysis or Interpretation: A.Ş., A.G., C.A., Literature Search: A.Ş., C.A., Writing: O.B.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

REFERENCES

1. Mackie-Savage UF, Lathlean J. The long-term effects of prolonged intensive care stay postcardiac surgery. J Card Surg. 2020;35:3099-107.
2. Seidel J, Whiting P, Edbrooke D. The costs of intensive care. Continuing Education in Anaesthesia Critical Care & Pain. 2006;6:160-3.
3. Loss SH, de Oliveira RP, Maccari JG, Savi A, Boniatti MM, Hetzel MP, et al. The reality of patients requiring prolonged mechanical ventilation: A multicenter study. Rev Bras Ter Intensiva. 2015;27:26-35.
4. Foxton MR, Al-Freah MA, Portal AJ, Sizer E, Bernal W, Auzinger G, et al. Increased model for end-stage liver disease score at the time of liver transplant results in prolonged hospitalization and overall intensive care unit costs. Liver Transpl. 2010;16:668-77.
5. Smith JO, Shiffman ML, Behnke M, Stravitz RT, Luketic VA, Sanyal AJ, et al. Incidence of prolonged length of stay after orthotopic liver transplantation and its influence on outcomes. Liver Transpl. 2009;15:273-9.
6. Yu PJ, Cassiere HA, Fishbein J, Esposito RA, Hartman AR. Outcomes of Patients With Prolonged Intensive Care Unit Length of Stay After Cardiac Surgery. J Cardiothorac Vasc Anesth. 2016;30:1550-4.
7. Delle Karth G, Meyer B, Bauer S, Nikfardjam M, Heinz G. Outcome and functional capacity after prolonged intensive care unit stay. Wien Klin Wochenschr. 2006;118:390-6.
8. Fakhry SM, Kercher KW, Rutledge R. Survival, quality of life, and charges in critically iii surgical patients requiring prolonged icu stays. J Trauma. 1996;41:999-1007.
9. Combes A, Costa MA, Trouillet JL, Baudot J, Mokhtari M, Gibert C, et al. Morbidity, mortality, and quality-of-life outcomes of patients requiring >or=14 days of mechanical ventilation. Crit Care Med. 2003;31:1373-81.
10. Ong AW, Omert LA, Vido D, Goodman BM, Protetch J, Rodriguez A, et al. Characteristics and outcomes of trauma patients with icu lengths of stay 30 days and greater: A seven-year retrospective study. Crit Care. 2009;13:154.
11. Miller RS, Patton M, Graham RM, Hollins D. Outcomes of trauma patients who survive prolonged lengths of stay in the intensive care unit. J Trauma. 2000;48:229-34.

12. Hartl WH, Wolf H, Schneider CP, Küchenhoff H, Jauch KW. Acute and long-term survival in chronically critically ill surgical patients: a retrospective observational study. Crit Care. 2007;11:R55.

13. Montuclard L, Garrouste-Orgeas M, Timsit JF, Misset B, De Jonghe B, Carlet J. Outcome, functional autonomy, and quality of life of elderly patients with a long-term intensive care unit stay. Crit Care Med. 2000;28:3389-95.

14. Friedrich JO, Wilson G, Chant C. Long-term outcomes and clinical predictors of hospital mortality in very long stay intensive care unit patients: A cohort study. Crit Care. 2006;10:R59.

15. Zampieri FG, Ladeira JP, Park M, Haib D, Pastore CL, Santoro CM, et al. Admission factors associated with prolonged (>14 days) intensive care unit stay. J Crit Care 2014;29:60-5.

16. Chalfin DB. Length of intensive care unit stay and patient outcome: The long and short of it all. Crit Care Med. 2005;33:2119-20.

17. Çevik B, Geyik FD. Prolonged stay in intensive care unit: Retrospective analysis of predisposing factors and outcome. Turk J Intensive Care. 2019;17:96-101.

18. Oliveira AB, Dias OM, Mello MM, Araújo S, Dragosavac D, Nucci A, et al. Factors associated with increased mortality and prolonged length of stay in an adult intensive care unit. Rev Bras Ter Intensiva. 2010;22:250-6.

19. Arabi Y, Venkatesh S, Haddad S, Al Shimemeri A, Al Malik S. A prospective study of prolonged stay in the intensive care unit: predictors and impact on resource utilization. Int J Qual Health Care. 2002;14:403-10.

20. Alkali B, Sarkinfada F, Takalma HU, Mada SB, Agwu E. Prolonged hospital stay in selected tertiary hospital in north- western kano state nigeria: Retrospective analysis of predisposing factors and outcome. Annals of Microbiology and Infectious Diseases. 2019;4:14-20.

21. Kıray G, İnal MT, Memiş D, Turan FN. Investigation of the Factors Affecting Prolonged Intensive Care Unit. J Turk Soc Intens Care. 2020;18:84-90.

22. Miniksar ÖH, Keten HS. Long length of stay in the intensive care unit (≥90 days): Retrospective analysis of predisposing factors and results. J Turk Soc Intens Care. 2021;19:184-91.

23. Zampieri FG, Ladeira JP, Park M, Haib D, Pastore CL, Santoro CM, et al. Admission factors associated with prolonged (>14 days) intensive care unit stay. J Crit Care. 2014;29:60-5.

24. Hughes M, MacKirdy FN, Norrie J, Grant IS. Outcome of long-stay intensive care patients. Intensive Care Med. 2001;27:779-82.

25. Santana Cabrera L, Sánchez-Palacios M, Hernández Medina E, Eugenio Robaina P, Villanueva-Hernández Á. Características y pronóstico de los pacientes mayores con estancia muy prolongada en una unidad de cuidados intensivos. Med Intensiva. 2008;32:157-62.

26. Cheung NH, Napolitano LM. Tracheostomy: Epidemiology, indications, timing, technique, and outcomes. Respir Care. 2014;59:895-915.

27. El-Anwar MW, Nofal AA, Shawadfy MA, Maaty A, Khazbak AO. Tracheostomy in the Intensive Care Unit: a University Hospital in a Developing Country Study. Int Arch Otorhinolaryngol. 2017;21:33-7.

28. Rahnemai-Azar AA, Rahnemaiazar AA, Naghshizadian R, Kurtz A, Farkas DT. Percutaneous endoscopic gastrostomy: indications, technique, complications and management. World J Gastroenterol. 2014;20:7739-51.

29. Vanis N, Saray A, Gornjakovic S, Mesihovic R. Percutaneous endoscopic gastrostomy (PEG): Retrospective analysis of a 7-year clinical experience. Acta Inform Med. 2012;20:235-7.

30. Bauer M, Gerlach H, Vogelmann T, Preissing F, Stiefel J, Adam D. Mortality in sepsis and septic shock in Europe, North America and Australia between 2009 and 2019- results from a systematic review and meta-analysis. Crit Care. 2020;24:239.

31. Spieth PM, Koch T, Gama de Abreu M. Approaches to ventilation in intensive care. Dtsch Arztebl Int. 2014;111:714-20.

32. Aygencel G, Türkoğlu M. Characteristics, outcomes and costs of prolonged stay icu patients. J Crit Intensive Care 2011;3:53-8.

33. Haribhai S, Mahboobi SK. Ventilator complications. In: Statpearls. Treasure Island (FL), 2022.

34. Baron DM, Franchini M, Goobie SM, Javidroozi M, Klein AA, Lasocki S, et al. Patient blood management during the covid-19 pandemic: A narrative review. Anaesthesia 2020;75:1105-13.

35. Keskin G, Hazır MS, Ünal D, Ergil J. The relationship between blood transfusions and mortality and length of stay in patients followed up with a diagnosis of covid-19 in intensive care units. Med J Bakirkoy. 2022;18:356-63.

36. Tobi KU, Amadasun FE. Prolonged stay in the intensive care unit of a tertiary hospital in Nigeria: Predisposing factors and outcome. Afr J Med Health Sci. 2015;14:56-60.

37. Halawi R, Moukhadder H, Taher A. Anemia in the elderly: A consequence of aging? Expert Rev Hematol. 2017;10:327-35.

38. Lipschitz D. Medical and functional consequences of anemia in the elderly. J Am Geriatr Soc. 2003;51(3 Suppl):10-3.

39. Takekawa D, Endo H, Hashiba E, Hirota K. Predict models for prolonged ICU stay using APACHE II, APACHE III and SAPS II scores: A Japanese multicenter retrospective cohort study. PLoS One. 2022;17:e0269737.

40. Laupland KB, Kirkpatrick AW, Kortbeek JB, Zuege DJ. Long-term mortality outcome associated with prolonged admission to the ICU. Chest. 2006;129:954-9.

41. Huang YC, Huang SJ, Tsauo JY, Ko WJ. Definition, risk factors and outcome of prolonged surgical intensive care unit stay. Anaesth Intensive Care. 2010;38:500-5.

42. Toptas M, Sengul Samanci N, Akkoc İ, Yucetas E, Cebeci E, Sen O, et al. Factors affecting the length of stay in the intensive care unit: Our clinical experience. Biomed Res Int. 2018;2018:9438046.

43. Luft J, Boes AA, Lazzari DD, Nascimento ERP, Busana JA, Canever BP. Chronic kidney injury at an intensive care service: Clinical characteristics and outcomes. Cogitare Enferm. 2016;21:1-9.

44. Hammond DA, Smith MN, Painter JT, Meena NK, Lusardi K. Comparative Incidence of Acute Kidney Injury in Critically Ill Patients Receiving Vancomycin with Concomitant Piperacillin-Tazobactam or Cefepime: A Retrospective Cohort Study. Pharmacotherapy. 2016;36:463-71.

45. Lee JW. Fluid and electrolyte disturbances in critically ill patients. Electrolyte Blood Press. 2010;8:72-81.