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How Effective are Intensive Care Unit Beds Used in Our Region?

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Abstract

Objective: The demand for critical care facilities is also growing in our country. The aim of the present study was to investigate the incidence and causes of inappropriate admissions to adult intensive care units (ICUs) in our region to facilitate the planning of bed numbers.

Methods: A team of specialists made an unannounced visit to level 1, 2 and 3 adult ICUs in 12 hospitals in our region between June 2014 and January 2015. A total of 290 ICU patients were evaluated.

Results: The rate of inappropriate ICU admission was 55.9%, and the most common reason was the lack of a lower level ICU. Palliative patients comprised 35.5% of the ICU patients, 68% of whom should have been in home care. The rate of inappropriate admission was 16.7% higher in open ICUs than in closed ICUs.

Conclusion: Our results indicate that instead of increasing the number of beds in level 2 and 3 ICUs, hospitals should increase the number of level 1 ICU beds. In addition, we believe that the existing beds could be utilised more effectively if all ICUs implemented a closed management style and if there was better coordination between ICUs.

Keywords: Intensive care unit, patient admission, triage, utilisation

Introduction

As patients' ages and comorbidities increase worldwide, the rate of intensive care unit (ICU) use is also increasing (1). Studies published in the USA have noted that the population is ageing, and that the demand for critical care services will increase in the future (2); therefore, ICU admission criteria should be restricted and redefined (3). Lowering the rate of unnecessary admissions to the ICU has been demonstrated to reduce expenses (4). Similar to the rest of the world, Turkey is also facing higher demand for critical care due to both a growing population and an increased life expectancy. The UK has 3 ICU beds per 100,000 people, whereas the USA has 20 ICU beds per 100,000 people (5). In Turkey, this ratio is 10 ICU beds per 100,000, which is rather high compared to England. However, there is still difficulty finding available beds in ICUs, suggesting that the ICUs are not used efficiently in our country. Many studies have investigated the effective use of ICU beds (3, 6). In one of these studies, the authors contend that implementing initiatives to accelerate patient turnover would be more effective than increasing the number of ICU beds (6). The results of a web-based survey (22 questions) completed by 121 medical ICU directors indicated that the seniority of the doctor admitting patients to the ICU changed depending on the time of admission. This resulted in an inability to strictly adhere to the patient admission protocols defined in the guidelines for intensive care

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admission published by the Society of Critical Care Medicine and the American Thoracic Society, and thus one-third of the admissions were inappropriate (3).

ICUs are labelled as open, closed or semi-closed, depending on how they are managed. In an open ICU, all doctors admit and treat their own patients, and the criteria for admission and discharge are defined by the admitting doctor. In a closed ICU, decisions regarding admission, discharge and treatment are made by intensivists. In semi-closed units, a coordinator is responsible for managing admission and discharge for different ICUs. Some studies have indicated that closed ICUs have a lower proportion of inappropriate admissions (6, 7).

The present study encompassed all of the adult ICUs in a zone of the province of Ankara, the capital of Turkey. The primary aim of the present study was to determine the prevalence and causes of inappropriate ICU admissions. Our secondary aim was to determine whether open or closed ICU management was associated with the rate of inappropriate admissions.

Methods

This cross-sectional study was approved by the Keçiören Training and Research Hospital Ethics Committee (Date: 08.04.2015; No:794). A team of experts paid one unannounced visit to the level 1, 2 and 3 adult ICUs of 12 hospitals operating under the Turkish Republic Ministry of Health, Ankara Zone 2 Secretary General of the Public Hospitals Administration of Turkey between June 2014 and January 2015 (8). Writen informed constent was obtained from the The Turkish Rebublic Ministry of Health to use audit data before the approval of the ethics committee. Six of the centres were training and research hospitals (TRHs) and six were state hospitals (SHs). During the visit, a prepared data collection sheet was used to note each patient's age, gender, comorbidities, reason for ICU admission, setting from which they were transferred to the ICU (emergency department, outpatient clinic, inpatient unit, surgery, other hospitals and other), ICU priority (priority system from 1 to 4 was used, with priority 1: patient who will benefit the most from ICU and priority 4: patient who will not benefit from the admission to the ICU in any way) (Table 1) (9), ventilator requirement, the unit or level ICU necessary based on their condition at admission and at the time of visit, whether they are a palliative care patient and whether the ICU is open or closed.

Statistical analyses

Statistical analyses and calculations were performed using IBM Statistical Package for the Social Sciences Statistics 21.0 (released 2012, IBM SPSS Statistics for Windows, version 21.0; IBM Corp., Armonk, NY, USA) and MS Excel 2007 software. The ltm (Latent Trait Models under IRT) module was used to calculate polychoric correlation coefficient in R software. All categorical variables included in the study were expressed in numbers (n) and percentages (%). Shapiro–Wilk test was used to assess the normal distribution of age data. Since the patients' ages did not show normal distribution, median (min and max) was used as descriptive statistics. Pearson's chi-square or Fisher's exact test was used to compare categorical variables. One-sample proportion test was used to determine whether the ratio of concurrence for the expected and actual ICU levels according to the patients' condition at admission and the time of visit differed by >0.50. The correlation between admission priority and ICU level was assessed using polychoric correlation coefficient. Kendall's τb test was used to determine whether the distribution among ICU levels varied based on admission priority. A p value <0.05 was accepted as statistically significant.

Results

A total of 290 patients in the ICUs of all the hospitals in the region at the time of the study visits were included in the study. Of these ICU patients, 68% were in TRHs, and 32% were in SHs. The mean age of the ICU patients was 65.6±18.1 years. There were 52.8% (n=153) male and 47.2% (n=137) female patients. The distribution of the patients in the different types and levels of ICU is shown in Table 2. Of the 21 ICUs, 16 (4 SHs and 12 TRHs) were closed, and 5 (4 SHs and 1 TRH) were open. Forty-seven (16.2%) patients were staying in open ICUs. Thirty-two (11.1%) patients were in level 1 ICUs, 117 (40.3%) patients were in level 2 ICUs, and 141 (48.6%) patients were in level 3 ICUs.

The patients' demographic characteristics and locations prior to ICU admission are shown in Table 3. Gender distribution

Table 1. Priority admission criteria

Priority 1	Unstable critical patients in need of intensive monitoring and treatment (Patients in this group have no treatment limitations)
Priority 2	Patients in need of intensive monitoring and possible emergency intervention (Patients in this group have no treatment limitations)
Priority 3	Unstable patients who are expected to undergo less improvement due to nature of underlying or acute disease (Patient in this group have treatment limitations)
Priority 4	Patients who will not benefit from intensive care treatment. Admission of these patients to ICU depends on the personal desicion of head of the ICU

ICU: intensive care unit

was similar in the different ICU levels (χ^2=0.030, p=0.985 and χ^2=0.565, p=0.754). In all three levels of ICU, most patients had been admitted from the emergency department (83.9% in level 1, 48.2% in level 2 and 38.2% in level 3 ICUs).

Table 2. Distribution of patients by ICU type and level

Intensive care unit	n (%)
Type	
Open	47 (16.2)
Closed	243 (83.8)
Level	
1	32 (11.1)
2	117 (40.3)
3	141 (48.6)

ICU: intensive care unit

Distributions of the primary admission diagnoses and comorbidities of the patients are listed in Table 4. The most common admission diagnosis was respiratory distress (32%), and the most frequent comorbidity was respiratory system disease (32.53%). Approximately half (52.2%) of the patients admitted to the ICUs were classified as priority 1. On the day of evaluation, 1.7% of the patients occupying the ICUs could have been discharged and 16.2% should have been transferred to inpatient units (Table 5). Only 165 (57.1%) patients were in the appropriate unit based on their condition at the initial admission (z=2.412, p=0.016) (Table 6). Overall, 128 (44.1%) patients were in the appropriate unit based on their condition on the day of the visit (z=1.997, p=0.046) (Table 7).

At the time of evaluation, 35.5% of the patients were under palliative care, 68% of whom should have continued with home care.

Table 3. Demographic characteristics and distribution of patients in level 1, 2 and 3 ICUs by the referring unit/centre

	Level				
	I n (%)	II n (%)	III n (%)	χ^2	p
Gender (n=290)					
Male	17 (53.1)	61 (52.1)	75 (53.2)	0.030	0.985
Female	15 (46.9)	56 (47.9)	66 (46.8)		
Age					
Median (min, max)	73.0 (33.0, 89.0)	70.0 (16.0, 93.0)	69.0 (19.0, 97.0)	0.565	0.754
Mean±SD	70.0±11.1	64.7±19.5	65.3±18.2		
Referring unit (n=281)					
Inpatient unit	0 (0.0)	23 (20.2)	36 (26.5)		**
Emergency department	26 (83.9)	55 (48.2)	52 (38.2)		
Surgery unit	1 (3.2)	15 (13.2)	11 (8.1)		
External centre	0 (0.0)	4 (3.5)	33 (24.3)		
Outpatient clinic	4 (12.9)	17 (14.9)	4 (2.9)		

*Column percentage, **Statistical test result cannot be given due to insufficient patient number. Min: minimum; max: maximum; SD: standard deviation; ICU: intensive care unit

Table 4. Patients' admission diagnoses and coexisting diseases

Indication for admission	n (%)	Coexisting diseases	n (%)
Respiratory distress	94 (32.41)	Neurological disease	94 (28.31)
Neurologic	44 (15.17)	Respiratory tract diseases	108 (32.53)
Postoperative	40 (13.79)	Kidney disease	19 (5.72)
Cardiac	36 (12.41)	Cardiac disorders	45 (13.99)
Pregnancy-related conditions	10 (3.45)	Hypertension	22 (6.63)
Monitorisation	23 (7.93)	Diabetes mellitus	11 (3.31)
Deterioration of general condition	17 (5.86)	Sepsis	9 (2.71)
Sepsis	7 (2.41)	Cancer	16 (4.82)
Trauma	4 (1.38)	Post-CPR	8 (2.41)
Intoxication	3 (1.03)		
Acute kidney failure	5 (1.72)		
Other	7 (2.41)		

Table 5. Distribution of patients according to several variables regarding the expected and actual level of care

	n (%)		n (%)
Admission priority		**Appropriate unit based on the current condition on the day of evaluation**	
1	151 (52.2)	1	85 (29.3)
2	108 (37.4)	2	69 (23.8)
3	11 (3.8)	3	78 (26.9)
4	19 (6.6)	Home care	5 (1.7)
Appropriate unit based on general condition at the time of th initial admission		Inpatient unit	47 (16.2)
Level 1 ICU	99 (34.3)	Discharge	6 (2.1)
Level 2 ICU	79 (27.4)	Palliative care patient? (n=287)	
Level 3 ICU	96 (33.2)	Yes	102 (35.5)
Home care	1 (0.3)	No	185 (64.5)
Inpatient unit	14 (4.8)	Plan for palliative care patients (n=101)	
Reason for not being admitted to the appropriate unit at the initial admission		Home care	69 (68.3)
Lack of lower level ICU	45 (70.3)	Continue care in ICU	32 (31.7)
Inpatient unit did not accept patient	9 (14.1)		
Other	10 (15.6)		

ICU: intensive care unit

Table 6. Comparison of the unit at the time of visit with the appropriate unit based on admission status among patients in level 1, 2 and 3 ICUs

Appropriate unit based on the condition at the initial admission	Level			Total n (%)
	1 n (%)	2 n (%)	3 n (%)	
Consistent with level of ICU	32 (100.0)	45 (38.5)	88 (62.9)	165 (57.1)
Not consistent with level of ICU	0 (0.0)	72 (61.5)	52 (37.1)	124(42.9)
Total	32 (100.0)	117 (100.0)	140 (100.0)	289 (100.0)

χ^2=26.587, p<0.001. ICU: intensive care unit

Table 7. Comparison between actual unit and appropriate unit based on the condition at the time of visit among patients in level 1, 2 and 3 ICUs

Appropriate unit based on the condition on the day of study evaluation	Level			Total n (%)
	1 n (%)	2 n (%)	3 n (%)	
Consistent with level of ICU	23 (71.9)	35 (29.9)	70 (49.6)	128 (44.1)
Not consistent with level of ICU	9 (28.1)	82 (70.1)	71 (50.4)	162 (55.9)
Total	32 (100.0)	117 (100.0)	140 (100.0)	290 (100.0)

χ^2=21.319, p<0.001.ICU: intensive care unit

There was a statistically significant difference between the patients' admission priorities and the level of the ICU to which they were admitted (p<0.001). Of the patients who were in priority 1, 69.5% were staying in level 3 ICUs (Table 8). Twenty-eight (93.3%) priority 3 and 4 patients were staying in level 2 and 3 ICUs (p<0.001). The rate of inappropriate admission was 10.4% among priority 3 and 4 patients. Mechanical ventilatory support was being provided to 31.7% of the patients.

The distribution of the admission priorities of patients in each type of unit is presented in Table 9. Priority 3 and 4 patients accounted for 27.7% of the patients in open ICUs and 7% of the patients in closed ICUs (z=3.983, p<0.001).

The distribution of units that the patients in each type of ICU should have been admitted to according to their condition at the time of visit is listed in Table 10. Based on their condition

Table 8. Distribution of patients in level 1, 2 and 3 ICUs according to admission priority

Admission priority	Level			Total n (%)
	1 n (%)	2 n (%)	3 n (%)	
1	1 (0.7)	45 (29.8)	105 (69.5)	151 (100.0)
2	29 (26.9)	51 (47.2)	28 (25.9)	108 (100.0)
3 or 4	2 (6.7)	21(70.0)	7 (23.3)	30 (100.0)
Total	32 (11.1)	117 (40.5)	140 (48.4)	289 (100.0)

Kendall's τ_b=−0.415, p<0.001

Table 9. Distribution of patients in open and closed ICUs according to admission priority

Admission priority	Unit type		
	Open n (%)	Closed n (%)	Total n (%)
1	10 (21.3)	141 (58.3)	151 (52.2)
2	24 (51.0)	84 (34.7)	108 (37.4)
3 or 4	13 (27.7)	17 (7.0)	30 (10.4)
Total	47 (100.0)	242 (100.0)	242 (100.0)

χ^2=29.265, p<0.001. ICU: intensive care unit

Table 10. Distribution of the appropriate unit based on the condition at the time of evaluation among patients in open and closed ICUs

Appropriate unit based on the current condition on the day of study evaluation	Unit type		
	Open n (%)	Closed n (%)	Total n (%)
Level 1	22 (46.8)	63 (28.1)	85 (29.3)
Level 2	9 (19.1)	60 (24.7)	69 (23.8)
Level 3	0 (0.0)	78 (32.1)	78 (26.9)
Home care	1 (2.1)	4 (1.6)	5 (1.7)
Inpatient units	15 (31.9)	32 (13.2)	47 (16.2)
Discharge	0 (0.0)	6 (2.5)	6 (2.1)
Total	47 (100.0)	243 (100.0)	290 (100.0)

z=2.430, p=0.015. ICU: intensive care unit

on the day of the visit, 34% (n=16) of the patients in the open ICUs and 17.3% (n=42) in the closed ICUs were suitable for home care, transfer to an inpatient unit or discharge (z=2.430, p=0.015).

Discussion

In our study, at the time of our visit, some ICU occupants were determined to be palliative care patients and open ICUs had a higher proportion of patients without a valid ICU indication than closed ICUs.

The average ICU occupancy rate was 86.65%. The highest occupancy rate was 98.8%. ICU occupancy rates were reported to be 98% for a hospital in Ireland and 78% for a hospital in Scotland (10). Another study indicated that the USA had an ICU occupancy rate of 68% (11). The former of those studies reported that nearly two-thirds of the patients were admitted outside working hours, suggesting they were emergency cases. Another study performed in the USA discusses an inpatient care model designed to reduce the need for ICU, as well as perioperative changes including fast-track anaesthesia and a post-anaesthetic care unit (12). Ranhoff et al. (13) emphasised that changes, such as increased use of non-invasive ventilation in inpatient units rather than in ICUs and the development of units, such as subintensive care, intermediate and stepdown units, reduce the demand for ICUs.

Various studies have investigated whether inappropriate ICU occupancy could be attributed to delayed discharge or to ICU physicians lacking the authority to deny inappropriate cases due to the ICU model of patient admission. The authors of one such study contended that closed ICUs are ideal, offering more efficient use of resources, lower rates of mortality and shorter hospital stays than open ICUs (14). Some authors have reported that one of the main strategies for reducing delayed patient discharge is to coordinate a discharge plan in consultation with social services and in coordination with nursing care management shortly after the patients are admitted to the ICU. Private in-home care services of nursing homes are emphasised to be used for this purpose (4, 15, 16). Failure to coordinate between ICUs and inpatient units or insufficient hospital beds have also been implicated in the needless extension of ICU stays among patients ready for discharge, which can lead to low bed turnover even in semi-closed ICUs (17). Johnson et al. (18) investigated delayed transfer to the ICU and determined that the most common reason is insufficient surgical beds. In our study, the proportion of patients who were not in the appropriate unit was 42.9% at the first admission and increased to 55.9% on the day of our visit. The most common reason for unnecessary ICU admission or admission to an inappropriate level ICU was determined to be the lack of a lower level ICU in the hospital. Open ICUs had a 16.7% higher proportion of inappropriate admissions (patients suitable for care at home or in an inpatient unit and those ready for discharge). Open ICUs also received more priority 3 and 4 patients from admission and more patients from inpatient units than closed ICUs. The increase in the proportion of inappropriate ICU occupancy

between first admission and our evaluation may be evidence of flaws in discharge planning. This increase may also be due to the fact that not every hospital in our region has a level 1 ICU. Considering that higher level ICUs are progressively more expensive, centres without a level 1 ICU should plan on opening such units. Furthermore, we believe that transferring palliative patients to palliative care centres would enable more efficient use of ICU beds in our country.

Kollef et al. (19) emphasised that owing to health care expenditures, patients with reversible medical conditions expected to show substantial recovery should be admitted to the ICUs. Another study indicated that the number of ICU beds per capita was not strongly correlated with health care expenditures, but strongly correlated with mortality (20). In addition, in another study, admission to the ICU was found to be correlated to low hospital mortality (21). Metcalfe et al. (22) reported that patients whose ICU admission is rejected have 46% higher 90-day mortality than those admitted to the ICU. However, scarcity of beds may result in delayed admission to the ICU. A study comparing the USA and UK with respect to ICU admissions showed that ICU admission took substantially longer after hospital admission in England and that more patients were admitted from the inpatient units rather than the emergency department (5). In a similar study, patients who were transferred to the ICU after staying in the emergency department >6 h had higher risk of death and longer hospital stays (23). In our study, most ICU admissions were found to be from the emergency department. However, owing to unreliable records, our analysis did not include data on the interval between emergency and ICU admissions.

In the USA, between 10% and 30% of the patients in the ICU were reported to receive ventilatory support and that most patients were admitted solely for monitoring (24). The proportion of patients receiving ventilatory support was comparable in our study. The fact that only 11.1% of the patients in our study were in level 1 ICUs suggests that fewer patients were admitted only for monitoring.

Sirio et al. (25) determined that strict adherence to the admission priority criteria is an important quality of the best performing ICUs. In our study, patients evaluated as priority 3 and 4 constituted 10.4% of the patients admitted to all level ICUs and 93.3% were admitted to level 2 and 3 ICUs. It may be difficult to determine which populations are in too good or too poor condition to benefit from the ICU (26). For example, patients with drug intoxication are commonly admitted. However, Brett et al. (26) have shown that critical care interventions are not necessary unless clinical high-risk factors are identified. Nevertheless, they reported that 70% of these low-risk patients are admitted to the ICU for observation (27). In another study, the majority of the patients admitted to the ICU were those with respiratory failure, trauma and neurosurgery, whereas intoxication accounted for a mere 0.6% of ICU admissions (28). In a Turkish study, the most common indications for ICU admission were hemodynamic instability, respiratory failure, changes of mental status and monitoring; these indications were mostly accompanied by chronic obstructive pulmonary disease, diabetes mellitus (DM), hypertension (HT) and coronary artery disease (6). The most common indications for ICU admission in the present study were respiratory failure, neurological and cardiac problems and postoperative monitoring. Intoxication accounted for 1% of indications for ICU admission. The most common coexisting diseases in addition to the ICU admission diagnoses were DM and HT.

The patients in our study showed comparable age and gender distribution between closed and open units. The significant negative correlation between admission priority and ICU level indicates that patient admissions to closed ICUs are managed more effectively. A study evaluating the shift from open to closed ICU management, in which admissions are conducted by critical care specialists, showed that patients with higher APACHE II scores were admitted to the surgical ICU; yet, mortality rates were lower in patients from closed ICU than in those from open ICU (7). Some researchers claim that closed ICUs allow for more effective use of resources and help reduce the mortality rates and shorten stays in the ICU (14, 29). However, since our study was conducted on the basis of spontaneous visits, we did not evaluate the mortality rates or length of ICU stays. Furthermore, the fact that admission priority 3 and 4 patients accounted for only 7% of the patients in closed ICUs shows that indications for ICU admission are more accurate in closed ICUs. Although we believe that the closed ICU management style is superior with respect to the accuracy of indications for ICU admission, further studies are still needed on this topic.

Conclusion

The rate of inappropriate ICU admission in our study was 55.9%, and the most common reason for this was the lack of a lower level ICU. Palliative patients comprised 35.5% of the patients in the ICUs and 68% of these patients should have been in home care. The rate of inappropriate admissions was found to be 16.7% higher in open ICUs than in closed ICUs. If our study is considered representative of Turkey overall, it is clear that merely increasing the number of beds in level 2 and 3 ICUs will not be sufficient to meet the growing demand for critical care. Instead, the priority should be to increase the number of level 1 ICU beds or create alternative facilities, such as post-anaesthetic care units in these hospitals. In addition, we believe that the existing beds could be utilised more effectively if the closed management style was implemented universally and there was better coordination between ICUs.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Keçiören Training and Research Hospital Ethics Committee (Date: 08.04.2015; No:794).

Informed Consent: Due to the retrospective design of the study, informed consent was not taken.

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References

1. Seferian E, Williams A. Intensive care unit use at the end of life: a population-based analysis: 299. Crit Care Med 2004; 32: A82. [CrossRef]
2. Angus DC, Kelley MA, Schmitz RJ, White A, Popovich J. Current and projected workforce requirements for care of the critically ill and patients with pulmonary disease. JAMA 2000; 284: 2762-70. [CrossRef]
3. Walter KL, Siegler M, Hall JB. How decisions are made to admit patients to medical intensive care units (MICUs): a survey of MICU directors at academic medical centers across the United States. Crit Care Med 2008; 36: 414-20. [CrossRef]
4. Zimmerman JE, Alzola C, Von Rueden KT. The use of benchmarking to identify top performing critical care units: a preliminary assessment of their policies and practices. J Crit Care 2003; 18: 76-86. [CrossRef]
5. Wunsch H, Angus DC, Harrison DA, Linde-Zwirble WT, Rowan KM. Comparison of medical admissions to intensive care units in the United States and United Kingdom. Am J Respir Crit Care Med 2011; 183: 1666-73. [CrossRef]
6. Uysal N, Gündoğdu N, Börekçi Ş, Dikensoy Ö, Bayram N, Uyar M, ve ark. Üçüncü basamak merkezde dahili yoğun bakım hastalarının prognozu. Yoğun Bakım Derg 2010; 1: 1-5.
7. van der Sluis FJ, Slagt C, Liebman B, Beute J, Mulder JW, Engel AF. The impact of open versus closed format ICU admission practices on the outcome of high risk surgical patients: a cohort analysis. BMC Surg 2011; 11: 18. [CrossRef]
8. Haupt MT, Bekes CE, Brilli RJ, Carl LC, Gray AW, Jastremski MS, et al. Guidelines on critical care services and personnel: recommendations based on a system of categorization of three levels of care. Crit Care Med 2003; 31: 2677-83. [CrossRef]
9. Guidelines for intensive care unit admission, discharge and triage. Crit Care Med 1999; 27: 633-8. [CrossRef]
10. Slattery E, Basavaraju N, Ahmed S, Kaur G, Hegarty A, Ahmed M, et al. Intensive care in a general hospital: demographics, utilization and outcomes. Irish J Med Sci 2014; 183: 649-52. [CrossRef]
11. Halpern NA, Pastores SM. Critical care medicine in the United States 2000–2005: an analysis of bed numbers, occupancy rates, payer mix, and costs. Crit Care Med 2010; 38: 65-71. [CrossRef]
12. Hill NS. Where should noninvasive ventilation be delivered? Respiratory Care 2009; 54: 62-70.
13. Ranhoff AH, Rozzini R, Sabatini T, Cassinadri A, Boffelli S, Ferri M, et al. Subintensive care unit for the elderly: a new model of care for critically ill frail elderly medical patients. Intern Emerg Med 2006; 1: 197-203. [CrossRef]
14. Chowdhury D, Duggal AK. Intensive care unit models: Do you want them to be open or closed? A critical review. Neurology India 2017; 65: 39.
15. Sprung CL, Danis M, Baily MA, Chalfin DB, Dagi TF, Davila F, et al. Consensus statement on the triage of critically III patients. JAMA 1994; 271: 1200-3. [CrossRef]
16. Selker HP, Beshansky JR, Pauker SG, Kassirer JP. The epidemiology of delays in a teaching hospital: the development and use of a tool that detects unnecessary hospital days. Medical Care 1989: 112-29. [CrossRef]
17. Eraghi MG, Beigmohammadi MT, Soleimani AA, Mojtahedzadeh M. Intensive Care Unit Staff and Resource Utilization: Is It an Effective Factor? Iran J Public Health 2013; 42: 1021-5.
18. Johnson DW, Schmidt UH, Bittner EA, Christensen B, Levi R, Pino RM. Delay of transfer from the intensive care unit: a prospective observational study of incidence, causes, and financial impact. Crit Care 2013; 17: R128. [CrossRef]
19. Kollef MH, Schuster DP. Predicting intensive care unit outcome with scoring systems: Underlying concepts and principles. Crit Care Clin 1994; 10: 1-18. [CrossRef]
20. Wunsch H, Angus DC, Harrison DA, Collange O, Fowler R, Hoste EA, et al. Variation in critical care services across North America and Western Europe. Crit Care Med 2008; 36: 2787-e8. [CrossRef]
21. Azoulay É, Pochard F, Chevret S, Vinsonneau C, Garrouste M, Cohen Y, et al. Compliance with triage to intensive care recommendations. Crit Care Med 2001; 29: 2132-6. [CrossRef]
22. Metcalfe MA, Sloggett A, McPherson K. Mortality among appropriately referred patients refused admission to intensive-care units. Lancet 1997; 350: 7-11. [CrossRef]
23. Chalfin DB, Trzeciak S, Likourezos A, Baumann BM, Dellinger RP, group D-Es. Impact of delayed transfer of critically ill patients from the emergency department to the intensive care unit. Crit Care Med 2007; 35: 1477-83. [CrossRef]
24. Wunsch H, Wagner J, Herlim M, Chong D, Kramer A, Halpern SD. ICU occupancy and mechanical ventilator use in the United States. Crit Care Med 2013; 41: 2712-9. [CrossRef]
25. Sirio CA, Colemann MB, Mcgrath B. The impact of intensivist and ICU occupancy on rates of low risk monitör only admissions to the ICU. Chest 1997; 112: 16S.
26. Kollef MH, Canfield DA, Zuckerman GR. Triage considerations for patients with acute gastrointestinal hemorrhage admitted to a medical intensive care unit. Crit Care Med 1995; 23: 1048-54. [CrossRef]
27. Brett AS, Rothschild N, Gray R, Perry M. Predicting the clinical course in intentional drug overdose. Arch Intern Med 1987; 147: 133-7. [CrossRef]
28. Higgins TL, McGee WT, Steingrub JS, Rapoport J, Lemeshow S, Teres D. Early indicators of prolonged intensive care unit stay: Impact of illness severity, physician staffing, and pre–intensive care unit length of stay. Crit Care Med 2003; 31: 45-51. [CrossRef]
29. Logani S, Green A, Gasperino J. Benefits of high-intensity intensive care unit physician staffing under the Affordable Care Act. Crit Care Res Pract 2011; 170814. [CrossRef]