Use of intensive care unit priority model in directing intensive care unit admission in Sudan: A prospective cross-sectional study

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ABSTRACT

Background: The shortage of specialized intensive care beds is one of the principal factors that limit intensive care unit (ICU) admissions. This study explores the utilization of priority criteria in directing ICU admission and predicting outcomes.

Methods: This was a prospective cross-sectional study conducted in two ICUs in Sudan from April to December 2018. Patients were assessed for ICU admission and were ranked by priority into Groups 1, 2, 3, and 4 (1 highest priority and 4 lowest priority), and these groups were compared using independent t-test, Chi-square, and ANOVA.

Results: A total of 180 ICU admitted patients were enrolled, 53% were male. The prioritization categories showed that 86 (47.8%), 50 (27.8%), 13 (7.2%), and 31 (17.2%) were categorized as priority 1, 2, 3, and 4, respectively. Patients in priority groups 3 and 4 had significantly higher ICU mortality rates compared to those in groups 1 and 2 (P < 0.001), were likely to be older (P < 0.001), had significantly more comorbidities (P = 0.001), were more likely to be dependent (P < 0.001), and had longer ICU length of stay (P = 0.028).

Conclusion: Patients classified as priority 3 and 4 were predominantly older and had many comorbidities. They were likely to be dependent, stay longer in ICU, and exhibit mortality.

Key Words: Admission, appropriateness, categories, intensive care unit, priority

INTRODUCTION

Demand for intensive care unit (ICU) resources often exceeds supply; there is a worldwide shortage of the specialized ICUs beds and to meet the needs of eligible patients is a challenge and requires good plans, including ICU admission criteria. [1] ICU overutilization can increase the cost of care without improving outcomes. [2] To contain the cost and offer the quality of care, these beds should be appropriately utilized. [2,3] ICU admission triage is influenced by clinical and nonclinical factors. Clinical judgments could be surrounded by some bias. Therefore, the need for objective guidelines and triage score was raised. [4] This could benefit the patient as well as could help in resource allocation. [5] Significant over-triage may be deleterious if the service becomes overwhelmed, especially during high demand time, while under-triage has been associated with increased mortality. [6,7]

Few studies have examined the indications and outcomes of ICU care. [8] Kraiss et al. reported no difference in the outcome or complications between the group admitted to intensive care and those admitted to a general ward.
Admission and triage criteria were developed by many organizations and societies to improve the allocation of available resources. There are several existing models to consider; the diagnosis, the objective parameters, and the prioritization models. The combination of the first two is the most commonly used by rapid response teams. In the prioritization model, patients are selected following a specially structured triage system which prioritizes patients according to their needs and likelihood of benefiting from admission. This model classifies patients into one of four admission priorities, from priority 1 severe unstable patients who need intensive care and monitoring in an ICU to priority 4 patients for whom admission to an ICU is not indicated because they are too well or too sick to benefit from treatment in intensive care.

It takes into consideration patient’s condition, clinical diagnosis, bed availability, patient’s prognosis, objective parameters at the time of referral, and the potential to benefit from the interventions needed. This model demonstrated good reliability and validity, substantial correlation with physician’s assessments and with the established reference standard. Furthermore, it is also associated with clinical outcomes such as hospital mortality, palliative care consultation, and ICU admission. ICU triage service has an impact on patient flow by reducing the number of pending admissions and the number of patients waiting for discharge.

According to our best knowledge, there is no study in Sudan aimed to correlate the patient triage process for ICU admission with the prioritization criteria. We aimed to assess the appropriateness of admission to ICUs based on prioritization criteria.

**METHODS**

This is a prospective cross-sectional study, conducted between April and December 2018 in the ICU at Soba University Hospital and Omdurman Military Hospital-Sudan. The study was approved by the Soba center for Audit and Research (IRB 201903061), and consent was waived. Permission was taken from directors of ICUs and hospital administrations. The study included all adult (age ≥ 18 years) patients who were admitted to the ICUs during the study period. We excluded children and patients coming after elective surgery. Data were collected using a coded questionnaire filled by the researcher. The information was obtained by interviewing the patient or the patient next of ken as well as the admitting and ICU doctors. Moreover, data from patients’ paper-based medical records was used. The questionnaire covers demographic and clinical data, including diagnosis, reason for ICU admission, comorbidities, and the need for intervention (drugs, ventilation, and renal replacement therapy). Admitting and ICU doctors were requested to predict probable patient’s prognosis and subsequently to make a decision if they will admit this patient or not. Patient’s previous functional status was assessed based on the Katz index of independence in the activity of daily living. Moreover, both teams were requested to triage the patient to a hypothetical last ICU bed. Data were analyzed using IBM Statistical Package for the Social Science Statistics for Windows, version 21.0 (IBM Corp., Armonk, N.Y., USA). Independent t-test, Chi-square, and ANOVA tests were used, and P = 0.05 was used as a cut off for significance. The manuscript adheres to the STROBE guidelines.

**RESULTS**

In this study, 180 patients were enrolled, 96 (53%) were male. Their age ranged from 30 to 90 years, with the majority (44%) were >60 years. The mean duration of hospital stay was 19.4 ± 15.6 days; ranging from 1 to 125 days. The main reasons for ICU admission were ischemic stroke, septic shock, and post-cardiac arrest; the rest of the causes are shown in Table 1. According to the ICU admission priority criteria, 86 (47.8%), 50 (27.8%), 13 (7.2%), and 31 (17.2) were belonging to priority 1, 2, 3, and 4, respectively [Table 1].

ICU admission was indicated for monitoring for 57 (31.7%) patients and intervention for 123 (68.3%) patients. Moreover, the most common reason for intervention was mechanical ventilation (45.6%). While other reasons were the need for vasoactive drugs (10.6%), noninvasive mechanical ventilation (9.4%) and renal replacement therapy (2.8%). Hypertension, diabetes mellitus, chronic kidney disease in dialysis, and malignancies were seen in 37.8%, 28.9%, 6.7%, and 4.4%, respectively.

In this study, the primary admitting and ICU team anticipated survival in 65% and 67.2% of patients, survival with severe disabilities in 21.7% and 20.6% of patients and mortality in 13.3% and 12.2%, respectively. When there is a hypothetical bed constrains, i.e., to admit to the last ICU bed, 93.9% of the primary service and 76.1% of the ICU team were willing to provide that bed with P < 0.0001 [Table 2].

The majority of patients (86.1%) were previously independent; few patients were partially dependent (7.8%) or completely dependent (6.1%). In this study, 56% of the patients died, while 38% improved and 6% were referred to other facilities. Bout 87% of patients who did not survive underwent resuscitation (cardiopulmonary resuscitation [CPR] before death, while 13% were not offered CPR [Table 3].

The association between ICU admission priority categories and the age of patients showed that the patients in the age
group <40 years (33.7%) and from 40 to 65 years (37.2%) were more likely to be in priority-1. While patients’ age group more than 65 years (83.9%) were in priority-4. The difference was statistically significant ($P < 0.001$).

Regarding the patient’s previous factional status, data showed that most of the independent patients (54.8%) were found in priority-1, one-half of partially dependent patients in priority-3 and the vast majority of them completely dependent patients (90.9%) in priority-4. The difference was statistically significant ($P < 0.001$).

The association between ICU priority and the presence of comorbidities among patients admitted to ICU was not statistically significant ($P = 0.185$).

The highest mean of hospital stay was seen in priority-4 patients (33.1 ± 22.4 days) while the lowest mean (12.1 ± 11.5 days) in priority-2 patients. The difference was statistically significant ($P = 0.028$) [Table 3].

In terms of the outcomes, 72% of patients who survived hospitalization were in priority Group-2, while 87.1% of nonsurvivors were in priority Group-4 ($P < 0.001$). However, the association between ICU admission priority and resuscitation of patients admitted to ICU before death was not significant ($P = 0.237$) [Table 3].

### DISCUSSION

The increasing demand of critical care beds and the limited resources in health services call for better utilization of ICUs beds. In recent decades, efforts have been undertaken to create effective and objective evaluation methods.\[^{14}\]

In our study, there was no difference between the judgment of the requesting physician and ICU team regarding probable prognosis of patients supposed to be admitted to ICU. We wonder if this was related to over utilization of diagnosis and objective parameters criteria with little emphasis on prioritization criteria. Another reason, it could be related to the fact that most ICUs were staffed by young providers with limited experience in decision-making related to critical care issues. Physician level of experience and perception of patient can affect decision making significantly.\[^{15}\] When the ICU team was challenged by the last bed, a significant difference was noticed in the decision-making process. This raises a concern and an opportunity. The concern is, whether they execute decision-making differently during abundance and scarcity. The opportunity is the possibility of teaching them to apply the same principles applied during scarcity to all situations. Bed availability is one of the most common identified factors that influence the decision to accept or reject patient’s admission to ICU.\[^{16}\] Orsini et al. found that when there was no ICU bed available, only 33% of patients evaluated for admission were admitted. While when there were only one or two available beds the percentage increased to 69% and 91%, respectively.\[^{17}\] Similar results obtained by Robert et al. as he reported a significant higher number of patients admitted to low bed availability units than to low bed availability units, in addition to the fact that some patients who had been
admitted to high bed availability units were too sick or too well to benefit.\[18\] There is a growing consensus that clear and objective directives for ICU admission triage could benefit patients, resource allocation, and decision-making.\[12,19,20\]

Determining appropriateness of ICU care is complex; in addition to expected benefit, it must incorporate patient preferences, availability of ICU resources and levels of medical complexity manageable in non-ICU settings. Despite the apparent practicality of this subject, there is a subjective side to it because unfortunately the few studies that have investigated the indications for and the results of admission to ICUs have detected an inability to categorize patients with precision.\[3\]

In this study, it was observed that patients classified as priority 3 and 4 were older compared to priority 1 and 2 (P < 0.05). This was in agreement with the studies of Vanessa et al.,\[3\] Caldeira et al.,\[21\] Carneiro et al.,\[14\] and Sinuff et al.\[22\] and it can be explained by the prevalence of comorbidities among this age group. In addition, this group was likely to be dependent. The number and severity of comorbidities increase with age.\[23\] Atella et al. reported that 86% of adults older than 65 had at least one chronic condition and around 57% had two or more.\[24\]

Global ICU mortality rate range varies across the world. In our study, the mortality was very high (56%). In a study done in a collage hospital in Saudi Arabia, short-term mortality rate was 12.2%,\[25\] Vincent et al. stated that the ICU mortality rate based on data collected from 84 countries was 16.2% and 25.8% among patients with sepsis.\[26\] Our result was similar to a study done in Istanbul where the mortality rate in ICU was 52.3%.\[27\] We wonder if this high mortality in our study was related to selection criteria or other factors like competency of the staff and availability of resources. ICU mortality rates were higher for priority Groups 3 and 4 when compared to 1 and 2 priority groups (P<0.001). Similar findings were obtained by Rosa Ramos et al.\[21\] and Caldeira et al.\[21\] Because they were critically ill and had reduced likelihood of recovery due to underlying disease or the nature of their acute illness, they also had poor physician prediction. In this study, only 13% of our patients who did not survive were not offered CPR. Do-not-resuscitate (DNR) order itself is a considerable factor associated with ICU mortality.\[29\] Saha et al. reported that the mortality rate for all patients who were DNR was 33.4% in compare to about 5% mortality rate for all patients who were not DNR (P < 0.001).\[29\] This should be seen as an associated factor, since DNR is usually issued for those with increased mortality. In Sudan, the guidelines and application of DNR or end of life care are not clear yet and there is no documented local statistics.

The current study revealed that, patients in priority 1 and 2 were more likely to be completely independent in contrast to priority 3 and 4 (P < 0.05). These results consistent with the Brazilian study conducted by Carneiro et al. who found that patients classified as priority 3 and 4 were more unconscious and completely dependents.\[14\] Zampieri and Colombari had mentioned that mortality in ICU was associated with the age, more comorbidities and worse performance status. Impairment of performance status 1 week before admission is associated with increases both hospital and ICU mortality rates.\[30\]

Our study demonstrated that the patients classified as priority 3 and 4 had longer ICU stay compared to priority 1 and 2 (P<0.05). This may be due to coexistence of multiple comorbidities among patients under these classifications, in addition to being more dependents. This goes in the same line with the study done by Caldeira et al.\[21\]

**CONCLUSION**

The present study concludes that, the majority of the patients selected for ICU admission were priority-1. In addition, the patients classified as priority 3 and 4 were predominantly older and completely dependents. Patients admitted to the ICU exhibited an elevated mortality rate and this rate was significantly high among priority 3 and 4 patients. Decision-making to admit...
patient to ICU by ICU team showed variation during beds availability and beds shortage.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

Research quality and ethics statement
This study was approved by the Institutional Review Board / Ethics Committee at the Soba Center for Audit and Research (IRB 201903061). The authors followed applicable EQUATOR Network (http://www.equator-network.org/) guidelines during the conduct of this research project.

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