Critical Care Nursing

Iran J Crit Care Nurs. 2014;7(1):51-58

Journal home page: www.inhc.ir

Comparing performance of the intensive care units based on the mortality rate and structural standards in educational hospitals

Gholamhosein Falahinia[1], Ali Zareian*, Khodayar Oshvandi[1], Afshin Farhanchi[1], Abbas Moghimbeigi[1]

**1. Hamadan University of Medical Sciences, Hamadan, Iran*

ARTICLE INFO

Article type:
Original article

Article history:
Received: 8 Fev 2013
Revised: 24 Nov 2013
Accepted: 1Fev 2014

Key words:
Structural standards
IIntensive care units
SAPS3
Performance

* Correspondence Author: Ali Zareian
Hamadan University of Medical Sciences, Hamadan, Iran.
TEL:+982182880.
Email: az110ir@gmail.com

ABSTRACT

Aims: The aim of intensive care units of the hospitals is decreasing mortality rate and improving health of the society. This study was done with the aim of "studying and comparing the performance of intensive care units by determining mortality rate and finding its relationship with structural situation of these units".

Methods: This cross-sectional study was done during six months in 2011 in the intensive care units of educational hospitals in Hamadan. The study was done on 200 patients through convenient sampling in the intensive unit of Besat hospital and in two intensive care units of Shahid Beheshti hospital. Data collection tools included SAPS3 checklist that its validity and reliability were confirmed in different studies and a researcher-made structural standards checklist in three areas (human force, physical environment and medical equipment). The ratio of the actual death to the expected death (SMR: standardized mortality rate) was determined by SAPS3 and its relationship with the structural standard score was measured. For data analysis, Kruskal-Wallis, Mann-Whitney, chi-square and Spearman correlation coefficient and SPSS17 software were used.

Results: Based on the SAPS3 scoring system, the ration of the actual death to the expected death (SMR) was more than one in all the units of the study which means weak performance; in a way that SMR of Besat, Ghaem and Milad units were respectively; 2.29, 1.38 and 1.56. Structural situation score of the units of the study were also less than 50% of the standard in a way that Besat, Ghaem and Milad units had respectively 48%, 45% and 41% of the structural standards scores. There was no significant relationship between structural standards scores of the units of the study and their SMR performance score (p=0.66).

Conclusions: Performance score of all the three units was weak and regarding structural standards the mentioned units were less than moderate. It is necessary to try to improve structural standards and to decrease ratio of the actual death to the amount of death expected by managers, physicians, nurses and other staff of the intensive care units.

Please cite this paper as:
Falahinia Gh, Zareian A, Oshvandi Kh, Farhanchi A, Moghimbeigi A. Comparing performance of the intensive care units based on the mortality rate and structural standards in educational hospitals. Iran J Crit Care Nurs. 2014;7(1):51-58.

[Downloaded from mail.jccnursing.com on 2026-11-15]

1. Introduction

Intensive care units are the most important parts of every hospital; it is because of critical situation of the patients of these units. These patients need intensive cares for saving life and discharging without complications [1].

Intensive care units consume a large amount of hospital funding; they use at least eight percent of the total hospital budget [2]; so assessing quality and efficiency of the intensive care units of the hospitals is very important. High quality and appropriate medical and nursing cares need appropriate and standard structures [3].

One of the most important problems in intensive care units is high workload of medical staff, especially physicians and nurses that compromise the quality of care, increase nursing and medical errors, prolong hospital stay and increase death [4-6].

According to the idea of Donabdian, medical services quality needs three main elements; structure, process and outcome that include the following points:

1. Structure: includes physical features, staff and facilities (human force, environment and materials)
2. Process: necessary procedures and steps for providing health services (diagnosis, treatment and nursing processes)
3. Outcome or output: the effect of providing health services on the customers (results or effects of care and treatment processes on the patients) that include; survival, improvement, rehabilitation, improvement of life quality, satisfaction, complications and care cost [7].

Clinical outcome is the most important criteria for evaluating activity of intensive care units, the final result of nursing and medical interventions on the patients and an example of treatment staff performance. Clinical outcome includes three areas of survival, improvement (reaching to the previous mental physical level) and life quality that long-term survival is the most important one which is measured by assessing mortality rate [8]; so assessing mortality rate is one of the serious duties that does not only determine clinical outcomes but also evaluate the efficiency of medical and nursing intensive cares [9].

One of the best performance indexes for comparing performance of some units with each other is measuring actual death of the unit with standard mortality rate by using disease intensity scoring systems [10-17].

Considering different tools for predicting mortality rate of the patients in the present intensive care units made the researcher to use the most reliable and the last tools means SAPS3 that according to the present resources has priority over other systems. SAPS3 Disease severity scoring system had been used for about 18000 patients in 320 intensive care units of American and European countries from 2002 to 2005. Priority of this system over other systems has been proved and its validity and reliability have been achieved [13-15 and 18-21].

In this new system, in addition to all the patient's parameters, even coefficient for different geographical areas have been considered (Iran is among Eastern Mediterranean countries) [23-25].

For assessing quality of medical and nursing care of critically ill patients and evaluating performance of intensive care units, it is necessary to do several studies with the aim of improving cares quality.

There are several studies in this regard all over the world for measuring and comparing performance of intensive care units; also in Iran, there are limited studies in this regard which shows low quality of cares, high amount of death and low structural standards of intensive care units in compare with global and regional mean [26-30].

in Iran for measuring mortality rate and performance of intensive care units, SAPS3 system has been used rarely; it made us to compare performance of intensive care units in a study by using this reliable tool; this study had been done with the aim of comparing performance level of general intensive care units [or heterogeneous] of the educational

[Downloaded from mail.jccnursing.com on 2026-11-15]

hospitals in Hamadan by using SAPS3 scoring system and determining its relationship with the present structural standards to take a step in improving quality of cares and performance of intensive care units.

2. Method

It is a cross-sectional study which was done from May to October in 2011 in general intensive care units of educational hospitals in Hamadan, including; intensive care unit of Besathospital and Ghaem and Milad intensive care units in Shahid Beheshti hospital, this study was done for all the admitted patients in these units. Inclusion criteria included; 18 years old and above, lack of burns and no history of cardiac surgery in the patient [19].

In this study two tools of SAPS3 disease intensity scoring system (global standard) and structural standards checklist of intensive care units which was a researcher-made form regarding aims of the study based on the last existing national and global standards were used after achieving their reliability and validity.

SAPS3 includes three parts:

1. Parameters before admitting patient (age, history of disease and hospitalization, previous infections…)
2. Reasons of hospitalization in the intensive unit
3. Patient's physiologic disorders

This system totally includes 20 parameters and 61 items and every item has a score, total scores includes SAPS3 score of every patient and after that they were in SAPS3 formula, the percentage of eventual death of the patient (expected mortality rate) is achieved.

Structural standards checklist of intensive care units were designed in three parts including human force with 41 items, physical environment with 145 items and medical equipment with 39 items that their scientific validity or reliability were achieved by content validity method and by using views of the professors of nursing and midwifery college, anesthetists, and experienced nursing experts working in intensive care units.

Also importance degree (weight percentage) of the checklist items were determined by the views of the professors, physicians and nurses working in the units of the study and the score of every part was calculated by considering weight percentage, in a way that from all the scores of structural standard checklist (843 scores), human force, physical environment and medical equipment areas had respectively 175, 510 and 158 scores.

Scientific validity or reliability of the structural standards checklist was achieved through inter-observers reliability method, in a way that direct observation technique was used by some observers independent land the agreement degree (correlation coefficient) between results of the observers was calculated by the help of Kuder Richardson correlation coefficient (human force p=0.95, physical environment p=0.99 and medical equipment p=0.96).

Data collection from the documented information in the file of the patients with inclusion criteria was done during the first hour of patient's admission in intensive care unit with daily resort of the researcher and after completing SAPS3 form for every patient, percentage of eventual death of the

patient was calculated and documented according to the related formula, then in the end of every stage, the mean of expected death percentage of all the patients of the study was achieved and it was compared with actual (observed) mortality rate of the unit and based on the SAPS3 system, SMR (standardized mortality rate) (ratio of the actual death to the expected death) of the intensive care units was calculated and it was used as the performance criteria of the unit and an index for comparing performance of some units with each other [10,18,22,25].

Data collection related to the structural standards was done by the presence of the researcher and direct observation of the structural cases and completing its checklist in intensive care units, in different shifts and the

[Downloaded from mail.jccnursing.com on 2026-11-15]

total score of structural standards of the units was calculated. Ethical observations were met in this study and it has achieved medical ethics committee approval. Also the collected information is only for providing some suggestions in order to improve care quality and performance of the units of the study.

Data analysis was done by using descriptive statistic and Kruskal Wallis and Mann-Whitney non-parametric statistical tests in the environment of $SPSS_{17}$ software and also chi-square statistical test was used for assessing the status of data frequency and Spearman correlation coefficient was used for assessing probable relationship between death of the patients of the units and the status of the structural standards of the units.

3. Results

According to the achieved results in terms of gender frequency distribution, most of the patients in the units of the study (64.5%) were male and in terms of age frequency distribution, patients' age in Besat unit was less than the patients' age in Ghaem and Milad units, the highest percentage (38%) of the patients in Besat unit were in the age range of less than forty years old.

The scores mean of SAPS3 of the patients in Besat, Milad and Ghaem units were respectively 61,62 and 68 , according to these scores Ghaem unit had the highest percentage of patients' death (50.8) and Besat unit had the lowest (39.3) and statistical test showed significant difference among them (p=0.02).

Regarding the actual mortality rate of the patients of the study, actual death percentage of the patients hospitalized in Besat unit was 90% which was more than other units of the study. There was significant difference between expected and observed deaths of the units (p=0.01).

Expected mortality rate of Besat unit was less than other units, it is while its actual mortality rate was more than other units, so the amount of performance score of Besat unit has been more than other units (2.29) which means its lower performance score in compare with other units (table 1).

Regarding structural standards score of the intensive care units of the study, totally Besat unit had the highest structural standards score (405 scores or 48% of the total score), in three areas of structural standards in compare with other units (Table 2).

Finally, there was no significant relationship between structural standard scores of the units of the study and their performance score (p=0.66), in another word increase of structural standard score did not cause increase or decrease of performance score (Table 2).

4. Discussion

Totally performance of all the three units was weak. Performance of Ghaem intensive care unit was closer to global standards and was better than Milad and Besat intensive care units. The amount of actual death of all the units was

Table 1: eventual and actual death percentage and SMR level in intensive care units of the study.

unit	Patients' SAPS3 score	Patients' eventual death percentage	Patients' actual death percentage	Ratio of actual death to the expected death
Besat intensive care	15±61	24±39.3	90	2.29
Ghaem intensive care	14±68	23±50.8	70	1.38
Milad intensive care	11±62	19±41.7	65	1.56

[Downloaded from mail.jccnursing.com on 2026-11-15]

more than the expected mortality rate. Besat intensive care unit with 39% expected death showed the weakest performance according to SAPS3 disease intensity scoring system and 90% actual death of the patients during six months of the study.

Mourno et al. in a study which was done in intensive care units of different countries of the world (2005) achieved global and regional mean of performance score of intensive care units that its mean in the Mediterranean region was about one, while in our study, performance score of intensive care units was more than global and regional mean which can be due to weak performance of the units of the study [13].

In the case of low performance score of the units of the study, it seems that different factors are important, such as shortage of human force. In all the units of the study, the ratio of human force in compare with the number of the patients was less than standard, shortage of specialist physician of intensive care unit and specialist nurse of intensive care unit and other required staff of the unit were clear. Specialist physicians of intensive care units and educated nurses of intensive unit can improve the patient and decrease mortality rate by in time diagnosis and treatment of the critically ill patients.

The study of Pronavast et al. (1999) in intensive care units indicate that lack of a resident full-time physician, lack of special expertise in more than 50% of on-call physicians, lack of doing special rounds by the physicians, decrease of the ratio of the nurse to patient to less than one to two and lack of monthly evaluation of the unit performance cause increase of patients' death and thirty percent increase of hospitalization time [31].

The study of Broun and Sullivan (1989) shows that by changing physicians of intensive unit to specialist of intensive care units in Canada hospitals and their full-time presence along with doing daily rounds by the help of staff make 50% decrease of death of the unit patients [32].

During a review systematic study by Ralf et al. on thirteen articles from 1983 to 2005 with the title of the effect of specialization and achieving specific skills on improvement of the outcomes in intensive care units following points were achieved: changing physicians of general intensive care unit from internist to specialist of intensive care unit (having special board) caused 23% decrease of death and 20% decrease of hospitalization time and increased knowledge of the intensive care staff and full-time presence of intensive specialist along with

Table 2: Comparing the situation of structural standards and the ratio of actual death to the expected death of the intensive care units of the study

Intensive care unit	Structural standard percentage				SMR	Correlation coefficient
	Human force	Physical environment	Medical equipment	total		
Besat	64	39	59	48	29.2	p=0.66 r=0.5
Ghaem	59	39	46	45	38.1	
Milad	52	36	44	41	56.1	

[Downloaded from mail.jccnursing.com on 2026-11-15]

daily rounds with the physicians and staff and nurses' educational discussions decreased patients' death to 50% [33].

While in the units of the study of Ghaem and Milad, there was no resident specialist and physiotherapist, nutritionist, medical equipment engineer were not present in all the units circadian; therefore these results are in consistence with the above studies and confirm them. Another factor which is important in decreasing death is inappropriate structural situation and shortage of medical equipment.

Based on the achieved results by structural standards checklist tools in intensive care units, totally all the three units had structural standards less than 50%, in a way that intensive care unit of Besat, Ghaem and Milad achieved respectively 48%, 45% and 41% of the standards score. Structural status of the units of the study was not appropriate and they did not achieve accepted score of structural standards which is in consistent with the results of the study of Jadidi et al. (2008) in the intensive care units of hospitals in Markazi city [30].

Among other factors which were effective in decreasing performance score of the units of the study was their clinical management model. In the units of Ghaem and Milad, open management model (the specialist and the physician who admitted the patient were responsible for patients' clinical management) and in the Besat unit close management model (intensive care team and physician were responsible for all the responsibilities of intensive care of the admitted patients in intensive unit until the time of discharge) were performed.

In the study of Maltz et al. (1998), changing open care model (force to perform initial orders of the physician who admitted the patient) to close care model (intensive unit team had the full responsibility of the patients) cause decrease of death (50%) decrease of hospitalization time (50%) and decrease of the number of the days of needing ventilator (70%) decrease of complications (20%), decrease of the number of consultations (50%) and decrease of renal failure (70%) and as the result improvement of using sources [34].

Another aim of this study was determining relationship between performance of the intensive care units and their structural standards situation that based on Spearman statistical test, there was no significant relationship between structural situation of intensive care units of the study and their performance score (p=0.66) (Table 2).

Our result is in consistent with the study of Jadidi et al. in intensive care units of the hospitals in Markazi city [30]; improvement of structural situation of intensive care units of the hospitals in Markazi did not improve their performance, but it is inconsistent with the similar studies in other countries, several studies which have been done about structural standards situation of intensive care unit (human force, medical equipment and physical environment) indicate improvement of intensive care units performance and decrease of patients' death by increasing structural standards level of the units [31-34] which is probably due to limited samples (three hospitals) and the effect of another important confounding factors such as process standards.

Management policy and process standards of every hospital are specified for that hospital and beside structural standards they influence performance of intensive care units.

5. Conclusions

Performance score of all the three units were weak and the mentioned units regarding structural standards were less than the moderate level. It is necessary to try to improve structural standards and decrease ratio of actual death to the expected level by the managers, physicians, nurses and other staff of the intensive care units.

6. Acknowledgements

In the end it is necessary to thank and appreciate cooperation of nursing and midwifery college professors in Hamadan, dear head of Besat and Shahid Beheshti hospitals,

[Downloaded from mail.jccnursing.com on 2026-11-15]

supervisors of the units, physicians and nurses of Besat, Ghaem and Milad intensive care units in Hamadan and also deputy of research and technology of Medical Sciences University of Hamadan due to financial funding of this research.

References

1. Steele A. Scoring systems in intensive care. Current Anaesthesia &Critical Care. 1998;9:8-15.
2. Manimala Rao S. Organization of intensive care unit and predicting outcome of critical illness. J Anaesth. 2003;47(5):328-37.
3. Hosseini H. Structural and Process Standards in Emergency Ward of the Selected Hospital of Isfahan University of Medical Sciences. IJNMR. 2007;12(2):65-68. [Persian]
4. Ayse Gurses P. ICU Nursing Workload: Causes and Consequences. Agency for Healthcare Research and Quality. 2005.
5. Coombs M, Chaboyer W, Sole ML. Advanced nursing roles in critical care--a natural or forced evolution? J Prof Nurs. 2007;23:83-90.
6. Padilha K G. Nursing workload and staff allocation in an intensive care unit: a pilot study according to Nursing Activities Score (NAS). Intensive Crit Care Nurse. 2010;26:8-13.
7. Joshi SK. Quality Management In Hospitals.1nd ed. New Delhi, India: Jaypee Brothers Medical Publishers; 2010.
8. Ihnsook J. Predictive accuracy of severity scoring system: a prospective cohort study using APACHE III in a Korean intensive care unit. Int J Nurs Stud. 2003;40:219-26.
9. Silva A. Mortality assessment in intensive care units via adverse events using artificial neural networks. Artif Intell Med. 2006;36:223-34.
10. RAY B. Quality indicators for ICU: ISCCM guidelines for ICUs in India. Indian J Crit Care Med. 2009; 13:173-206.
11. Keegan MT. Severity of illness scoring systems in the intensive care unit. Crit Care Med. 2003;39:163-9.
12. Moreno RP. Characterizing performance profiles of ICUs. Curr Opin Crit Care. 2010;16:477-81.
13. Moreno RP. SAPS 3--From evaluation of the patient to evaluation of the intensive care unit. Part 2: Development of a prognostic model for hospital mortality at ICU admission. Intensive Care Med. 2005; 31:1345-55.
14. Khwannimit B. The performance and customization of SAPS 3 admission score in a Thai medical intensive care unit. Intensive Care Med. 2010;36: 342-6.
15. Mbongo CL, Monedero P, Guillen-Grima F, Yepes MJ, Vives M, Echarri G. Performance of SAPS3, compared with APACHE II and SOFA, to predict hospital mortality in a general ICU in Southern Europe. Eur J Anaesthesiol. 2009;26(11):940-5.
16. Toma T, Abu-Hanna A, Bosman RJ. Discovery and inclusion of SOFA score episodes in mortality prediction. J Biomed Inform. 2007;40(6):649-60.
17. Zimmerman JE, Kramer AA, McNair DS, Malila FM. Acute Physiology and Chronic Health Evaluation (APACHE) IV: hospital mortality assessment for today's critically ill patients. Crit Care Med. 2006;34(5):1297-310.
18. Metnitz PG, Moreno RP, Almeida E, Jordan B, Bauer P, Campos RA, et al. SAPS 3--From evaluation of the patient to evaluation of the intensive care unit. Part 1: Objectives, methods and cohort description. Intensive Care Med. 2005;31(10):1336-44.
19. Fink MP. Textbook of critical care. Fifth ed. New York. 2005:2195–206.
20. Ledoux D, Caninet JL, Preiser JC, Lefrancq J, Damas P. SAPS 3 admission score: an external validation in a general intensive care population. Intensive Care Med. 2008;34(10):1873-7.
21. Antonelli M, Azoulay E, Bonten M, Chastre J, Citerio G, Conti G, et al. Year in review in Intensive Care Medicine: I Acute renal failure, outcome, risk assessment and ICU performance, sepsis, neuro intensive care and experimental. Intensive Care Med. 2010;37(1):19-34.
22. 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(2):76-86.
23. Kesecioglu J. From intensive care to treatment of the critically ill. Current Anesthesia and Critical Care. 2000;11(1):150-8.
24. Afessa B, Keegan MT. Predicting mortality in intensive care unit survivors using a subjective scoring system. Crit Care. 2007;11(1):109.

[Downloaded from mail.jccnursing.com on 2026-11-15]

25. Teres D. The value and limits of severity adjusted mortality for ICU patients. J Crit Care. 2004;19(4):257-63.
26. Falahinia GH, Zareian A, Oshvandi KH, Farhanchi A, Moghimbigi A. Comparison of intensive care units Structural Standards. Iran J Crit Care Nurs. 2013;5(4): 224-9. [Persian]
27. Farmand f. Qualitative evaluation of intensive care unit in Baqiyatallah Azam Hospital using the apache II scoring system . Dissertation of a great era of Public Health. Tehran Univ Med Sci. 2001;62-72. [Persian]
28. Tarnow-Mordi WO. Hospital mortality in relation to staff workload: a 4-year study in an adult intensive-care unit. Lancet. 2000; 356:185-89.
29. Karimi M. Comparison of three methods APACHE, MPM, and SAPS of mortality scorning system in predict intensive care patients' mortality rate in Hamadan Mobasher Kashani hospital. PhD thesis in Medicine, Hamadan Univ Med Sci. 2007;23-27. [Persian]
30. Jadidi R, Noroozi A, Moshri E. The relationship between physical and human resources in the Intensive Care Units and patients mortality rate in Hospitals of Markazi Province's: 2007. Arak Univ Med Sci J. 2009;1 (2):29-38. [Persian]
31. Pronovost PJ. Organizational characteristics of intensive care units related to outcomes of abdominal aortic surgery. J Am Med Associat. 1999;281((2) :1310-17.
32. Brown JJ , Sullivan G. Effect on ICU mortality of a full-time critical care specialist. Chest. 1989;96(4):127-9.
33. Ralph J, Fuchs MD. Do intensivists in ICU improve outcome? Best Practice & Research Clinical Anaesthesiology. 2005;19(1):125-35.
34. Multz AS, Chalfin DB, Samson IM. A 'closed' medical intensive care unit (MICU) improves resource utilization when compared with an open MICU. Am J Res Crit Care Med. 1998;157:1468-73.

[Downloaded from mail.jccnursing.com on 2026-11-15]