ORIGINAL ARTICLE

Outcome of a semi-closed mixed intensive care unit in a medical college: A prospective observational study

Niraj Kumar Keyal[1], M.B.B.S., M.D., M.R.I.M., D.M., Jeetendra Kumar Mishra[2], M.B.B.S., M.D., Rupesh Mahato[3], M.B.B.S., M.D., Gaurav Gupta[4], M.B.B.S., M.D., Ujjawal Shah Kanu[1], M.B.B.S., Suchita Gupta[1], M.B.B.S., Sachit Sharma[5], M.B.B.S., M.D., D.M.

[1]Department of General Practice & Emergency Medicine - Critical Care Medicine Unit, [2]Department of Cardiology, [3]Department of Anesthesia, [4]Depatment of Orthopedics, National Medical College and Teaching Hospital, Birgunj, Nepal, [5]Department of Critical Care Medicine, Tribhuvan University Teaching Hospital, Kathmandu, Nepal.

Corresponding author:
Dr. Niraj Kumar Keyal
M.B.B.S., M.D., M.R.I.M., D.M. Critical Care Medicine
Department of General Practice & Emergency Medicine- Critical Care Medicine Unit
National Medical College and Teaching Hospital
Birgunj, Nepal.
Phone: +977-9855027141
Email: nirajkumarkeyal@gmail.com

ACCESS THIS ARTICLE ONLINE

⬇ View PDF

ABSTRACT

Background and aims: The patients with the most severe illnesses are admitted in intensive care unit (ICU). This study was conducted to explore the outcome of patients admitted to the intensivist led semi-closed mixed ICU of a medical college in Nepal.

Methods: Five hundred and forty-two patients with age 18 years or above, admitted to the level three ICU of National Medical College over one year period was included in the study. The outcome of the patient was defined as discharge to ward, death, leave against medical advice, or do not resuscitate.

Results: Out of 542 patients admitted in the ICU during the study period, 444 (82%) patients were discharged to the ward, 63 (12%) died, 24 (4%) left against medical advice and 11 (2%) gave do not resuscitate orders. Mortality in intubated and trauma patients was 25.0% and 4.7% respectively.

Conclusion: This study shows favourable results in terms of patient outcome in an intensivist led semi-closed mixed ICU of a medical college in Nepal.

Key Words: developing country, intensive care unit, mortality.

INTRODUCTION

Intensive care unit (ICU) generally runs in an open model where primary care is delivered by physicians, surgeons, and anaesthesiologist. Studies have shown that closed medical[1] or surgical[2,3] ICU run by an intensivist has a better outcome.

A semi-closed ICU is a model where there are mandatory consults, daily rounds and orders written by the consultant intensivist, or by the primary team in consultation with the consultant intensivist for all patients admitted in the ICU. Semi-closed ICU can be a better option to improve patient outcome with the collaborative effort of the critical care team and other disciplines.[4]

The current study aims to fill the gap in literature about the outcome of semi-closed ICU in a resource-limited setting.

METHODS

It was a prospective observational study in a level three intensive care unit of National Medical College (NMC), Birgunj, Nepal conducted between May 1, 2023 to April 30, 2024. Ethical approval from the Institutional Review Committee was obtained before commencing the study (ethical approval number: F-NMC/629/079-080). Written informed consent was obtained from the patient or surrogate decision-maker. All patients ≥ 18 years who were admitted to the mixed intensive care unit of NMC were included in the study. Patients were excluded if they were younger than 18 years, or refused to provide informed consent.

National Medical College has a 26 bedded level III intensive care unit and a 33 bedded high dependency unit (HDU). HDU is a level II step down unit. Both the ICU and HDU are managed by the intensivist in close collaboration with the admitting specialty or sub-specialty clinicians.

The critical care team consisted of a full-time intensivist, five anesthesiologists, 12 medical officers, nurses and a physiotherapist. The nurse-to-patient ratio was 1:3.

The intensivist had completed his post-graduation in emergency medicine and further specialized in Critical Care Medicine. Anaesthesiologists had completed their post-graduation in anaesthesiology. Nurses had obtained training in critical care medicine. The patients were thoroughly assessed by the intensivist and medical officer at the time of admission to the intensive care unit and further managed by critical care team in collaboration with the admitting clinician. Consultation with other specialty or sub-specialty was done as required.

The decision to extubate or transfer the patient out of ICU was made by the critical care team led by the intensivist. Family counselling about the clinical status and prognosis of the patient was done by the intensivist and admitting clinician. The management of patients was done based on standard protocol endorsed by the Nepalese Society of Critical Care Medicine (NSCCM). The intensivist held regular sessions to educate medical officers and nurses regarding these protocols and general issues related to critical care.

The variables entered in the preformed sheet were age, sex, occupation, ethnicity, Acute Physiology And Chronic Health Evaluation (APACHE) II score, Sequential Organ Failure Assessment (SOFA) Score, Injury severity score, diagnosis, intubation status, speciality, sub-speciality, co-morbidity, time lag between injury or symptom and presentation to the ICU and mode of admission in ICU.

The outcome of the patient were discharge to ward, death, leave against medical advice (LAMA), or do not resuscitate (DNR). The patient admitted to the intensive care unit who wishes to leave against the clinicians' advice were recorded in the LAMA category. Similarly, DNR was defined as a patient who was provided all treatment except cardiopulmonary resuscitation if the patient was already intubated at the time of decision for DNR. If the DNR was signed before the patient was placed on mechanical ventilation, then the patient was not intubated and was not provided CPR. LAMA and DNR order was signed by the surrogate decision-maker after discussing with the intensivist and admitting clinician. The reason for LAMA and DNR was recorded.

The variables recorded before the patient was shifted to the ward from the intensive care unit were days on mechanical ventilation and length of stay in the intensive care unit. The patient was then followed up in ward until they were discharged to home, another hospital or readmitted to intensive care unit. The reason for readmission and outcome of the readmitted patient was recorded.

Bias was reduced by collecting data from all groups of patients. Data collection was done in a preformed sheet. The sheet included all physiologic variables and demographic variables. All data was transferred to the excel sheet and transferred to SPSS-16. Values were presented as mean (± standard deviation; SD) or frequency. Only descriptive statistics were used in the study to present the results.
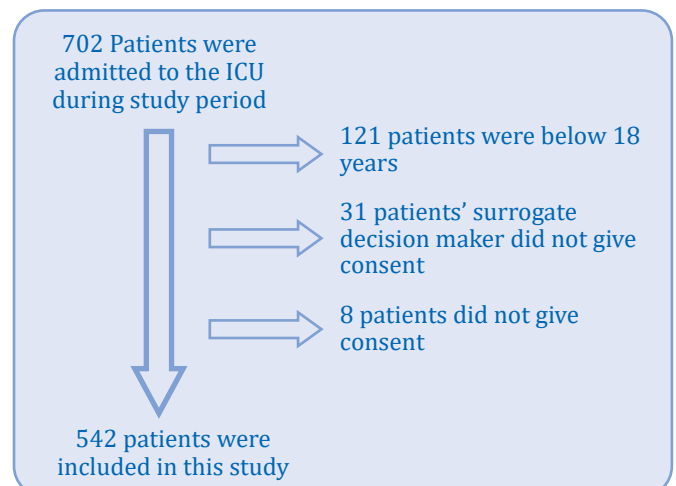
RESULTS

Figure 1. STROBE diagram of patients included in this study.

Of the 702 patients admitted to ICU during the study period, 542 were enrolled in the study (Figure 1).

Table 1. Demographic characteristics of the study population.

Parameters	n (%)
Age (years)	
18-35	168 (30.0)
36-60	194 (35.8)
>60	180 (33.2)
Sex	
Male	340 (62.7)
Female	202 (37.3)
Ethnicity	
Hindu	485 (89.5)
Kirat	39 (7.2)
Buddhist	13 (2.4)
Muslim	4 (0.7)
Christian	1 (0.2)
Occupation	
Unemployed	182 (33.6)
Farmer	126 (23.2)
Housewife	98 (18.1)
Student	51 (9.4)
Labour	31 (5.7)
Businessman	24 (4.4)
Technical worker	22 (4.0)
Army	8 (1.4)

Table 1 shows the demographics characteristics of the study population. Middle age patients were admitted more than younger and older age patients. Of them, 340 (62.7%) were male and 202 (37.3%) were female. Most of the patients in this study were Hindus and unemployed. Out of 542 patients, 352 (64.8%) patients did not have history of trauma and 191 (35.2%) had a history of trauma.

Table 2. Clinical characteristics of the study population.

Parameters	n (%)
Injury severity score	
<15	121(63.3)
≥15	70 (36.6)
APACHE II score at the time of admission	
3-10	340 (62.7)
11-20	131 (24.1)
21-30	47 (8.6)
31-40	24 (4.42)
SOFA score at the time of admission	
0-6	422 (77.8)
7-12	63 (11.6)
13-18	36 (6.6)
19-24	21 (3.8)
Time of presentation to ICU (hours)	
<6	74 (13.7)
6-12	58 (10.7)
12-24	113 (20.8)
>24	297 (54.9)
Mode of admission in ICU	
Direct	136 (25.0)
Refer	388 (71.5)
Ward	18 (3.3)

Table 2 shows the clinical characteristics of the study population. Among the trauma patients, 63.3% had injury severity score less than 15. Majority of the patient at the time of admission had APACHE II of 3-10 and SOFA score of 0-6. Most of patients were admitted after 24 hour of injury or illness, referred from other hospitals.

This study showed that 444 (81%) patients survived and were shifted to ward, 63 (12%) expired, 24 (5%) left the hospital against medical advice (LAMA) and 11(2%) gave do not resuscitate orders (DNR). Four hundred forty four patients survived and were shifted to the ward or high dependency unit. Seven (1.6%) patients got readmitted to the ICU. Out of

7 readmitted patients, 3 (42.8%) were again shifted to ward, 2 (28.5%) expired and 2 left against medical advice (28.5%).
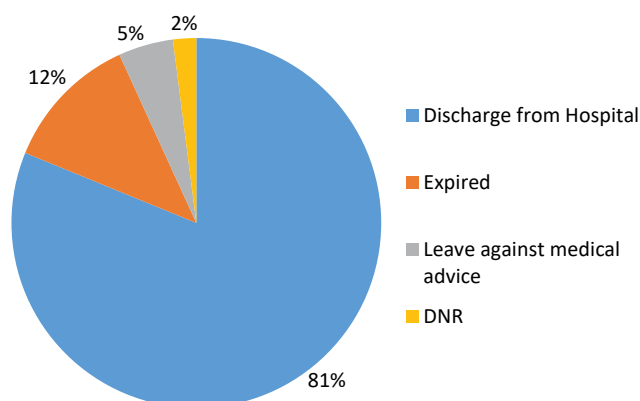

Figure 2. Outcome of patients admitted to the intensive care unit.

Figure 2 shows the outcome of the patients. Mortality rate in this study was 65 (12%). Forty four patients (67.7%) expired after 48 hours of ICU admission and 21 (32.3%) within 48 hours of ICU admission. Out of 542 patients, 144 (26.5%) were intubated and required mechanical ventilation. The minimum days on mechanical ventilation was 1 day and the maximum was 16 days. Mean days on mechanical ventilation was 3±2.2 days. Mortality in intubated patient was 25%. Out of 542 patients, 191 (35.2%) patients sustained trauma and their mortality was 9 (4.71%). The minimum length of stay (LOS) for all groups of patients in the ICU was 1 day and maximum was 51 days. Mean LOS in the ICU was 4.7 ± 4.9 days.

Table 3. Outcome of patients according to specialty

Specialty	Discharged n (%)	LAMA n (%)	DNR n (%)	Expired n (%)	Total n (%)
Otolaryngology	11 (84.6)	0	0	2 (15.3)	13 (100)
Internal Medicine	176 (72.1)	18 (7.3)	8 (3.2)	42 (17.2)	244 (100)
Obstetrics/ Gynaecology	11 (100)	0	0	0	11 (100)
OMFS	7 (100)	0	0	0	7 (100)
Orthopaedics	54 (88.5)	1 (1.6)	1 (1.6)	5 (8.1)	61 (100)
Psychiatry	3 (75)	0	0	1 (25)	4 (100)
Surgery	178 (88.1)	7 (3.5)	2 (1.0)	15 (7.4)	202 (100)
Total	**440 (81.2)**	**26 (4.8)**	**11 (2.0)**	**65 (12.0)**	**542 (100)**

Table 3 shows the outcome of patients according to speciality. This study showed that 100% of patients were discharged from obstetrics/gynaecology and oral maxillo-facial surgery followed by orthopaedics 54 (88.5%), surgery 178 (88.1%), otolaryngology 11 (84.6%), psychiatry 3 (75%) and internal medicine 176 (72.1%). Leave against medical advice, do not resuscitate and death was more in internal medicine.

DISCUSSION

Studies have shown that closed medical or surgical ICUs have a better outcome in critically ill patients. However due to many difficulties in running a completely closed ICU, a semi-closed model can be an alternative in developing country like ours. The current study was conducted to assess the outcome of a mixed semi-closed ICU.

Most of the studies[1-3] on the outcome of ICUs in the developing countries are retrospective audits on open ICUs. We designed a prospective study to add a new dimension to assess the outcome of a mixed semi-closed ICU.

In the present study, mortality was 12% while in other studies mortality varied from 17% to 35%.[5-11] In a study by Gundo et al.[12] mortality was 60.9% which was very high in comparison to our finding. One of the causes of this difference was probably the lack of intensivist, protocolized therapy and adequately trained nurses in their setup which was present in ours.

The present study shows that mortality in medical patients was 17.2% which was lower in comparison to a study by Vaidya et al.[8] where it was 25.6%. Mortality in surgical patients was 7.4% in our study while in other studies, it varied from 13.9% to 29.9%.[2,3,12] This difference again was may be due to a protocol driven practice in our ICU at current time which might not have been the case at the time the previous studies were conducted. Mortality in trauma patients was 4.7% which was also low in comparison to previous studies.

In our study, mortality in the intubated patients was 25% while in a study by Hamal et al[7] and Vaidya et al[8] it was 52.19% and 61.2% respectively. The incidence of Leave against Medical practice was 4% in our study while in other studies it varied from 8% to 21.6% in other studies.[6-10,13] This difference might reflect an improved affordability of critical care services bringing it within the reach of lower middle-class population and subsequent decrease in the incidence of Leave against Medical advice.

In our study, the incidence of DNR was 2% while in a study by Acharya et al[6] it was 3%. The population of Male was more (62.7%) than female (37.3%) in our study which was similar to the finding in other studies.[6-10] This reflects that female population is still deprived of critical care services in our setting due to various reasons and should draw attention of the concerned authorities to bring a change in this situation in future especially given the fact that the population of

female is higher than male in our country. The incidence of readmission in our study was 1.6% while in other studies it varied from 5% to 13.13%.[13,14] Mortality in the readmitted patients in our study was 28.5% while in a study by Ponzoni et al[14] it was 31%.

This study had few limitations. First, it was a single center study. Second, we did not compare patient outcome with similar open ICUs. Third, we did not follow the long-term outcome of the patients.

CONCLUSION

The use of protocol driven therapy in an intensivist led mixed semi-closed model of ICU helps to improve patient outcome.

Acknowledgements: None

REFERENCES

1. Multz AS, Chalfin DB, Samson IM, et al. A "closed" medical intensive care unit (MICU) improves resources utilization when compared with an "open" MICU. Am J Respir Crit Care Med. 1998;157(5 Pt 1):1468-73. [PubMed | Google Scholar | DOI]

2. 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. [PubMed | Google Scholar | DOI]

3. Chittwatanarat K, Pamorsiniapathum T. The impact of closed ICU model on mortality in general surgical intensive care unit. J Med Assoc Thai 2009;92(12):1627-34. [PubMed | Google Scholar]

4. Chowdhury D, Duggal AK. Intensive care unit models: Do you want them to be open or closed? A critical review. Neurol India. 2017;65(1):39-45.   [PubMed | Google Scholar | DOI]

5. Koirala S, Ghimire A, Sharma A, Bhattarai B. ICU admission and outcomes in a community-based tertiary care hospital: an audit of one year. Health Renaissance. 2011;9(2):83-7. [Google Scholar | DOI]

6. Acharya SP, Bhattarai A, Bhattarai B. An Audit of An intensive Care Unit of A Tertiary Care Hospital. J Nepal Med Assoc. 2018;56(512):759-62. [PubMed |Google Scholar| DOI]

7. Hamal AB, Hyoju S, Rana S, Shah J. Patients Presenting in Intensive Care Unit of Nepal Police Hospital: An Overview. J Anest & Inten Care Med. 2019;9(2):0037-40. [Google Scholar| DOI]

8. Vaidya PR, Shrestha RR. Outcome of the Patients Admitted in New Intensive Care Unit, Bir Hospital: Five years review. PMJN 2015;15(1):1-5.

9. Khanduri S, Katiyar S, Kishore N, Sodhi R, Aggarwal A. Retrospective review of profile of intensive care unit admissions and outcomes in a tertiary care hospital of Himalayan region. IJRMS. 2017;5(11):4715-8. [DOI]

10. Mendsaikhan N, Begzjav T, Lundeg G, Dunser MW. The epidemiology and outcome of critical illness in Mongolia: A multicenter, prospective, observational cohort study. Int J Crit Illn Inj Sci. 2016;6(3):103-8. [PubMed | Google Scholar | DOI]

11. Sulieman H, EI-Mahdi W, Awadelkareem M, Nazer L. Characteristics of Critically-Ill Patients at Two Tertiary Care Hospitals in Sudan. Sultan Qaboos Univ Med J. 2018;18(2):e190-5. [Pub Med | Google Scholar | DOI]

12. Gundo R, Lengu ES, Maluwa A, Mtalimanja O, Chipeta D, Kadyaudzu C. An Audit of Admissions to Intensive Care Unit at Kamuzu Central Hospital in Malawi. Open Journal of Nursing. 2014;4:583-89. [Google Scholar | DOI]

13. Paul G, Gautam PL, Khullar R, Paul BS. Prospective evaluation of patients leaving against medical advice of a tertiary care hospital: comparison of emergency and intensive care units. Int J Med Public Health. 2018;8(1):18-23. [Google Scholar | DOI]

14. Ponzoni CR, Correa TD, Filho RR, et al. Readmission to the intensive care unit: Incidence, risk factors, resource use, and outcomes. A retrospective chohort study. Ann Am Thorac Soc. 2017;14(8):1312-9 [PubMed | Google Scholar | DOI]

15. Hefny AF, Idris K, Eid HO, Abu-Zindan FM. Factors affecting mortality of critical care trauma patients. Afr Health Sci. 2013;13(3):731-5. [PubMed | Google Scholar | DOI]

16. Lentsck MH, Oliveria RR, Corona LP, Mathias TAF. Risk factors for death of trauma patients admitted to an intensive care unit. Rev Latino Am Enfermagen. 2020;25:e3236.   [PubMed | Google Scholar | DOI]

17. Xu J, Tong L, Yao J, et al. Association of sex with clinical outcome in critically ill sepsis patients: A retrospective analysis of the large clinical database MIMIC-III. Shock. 2019;52(2):146-51. [PubMed | Goolge Scholar | DOI]

18. Groenland CNL, Termorshuizen F, Rietdijk WJR, et al. Emergency department to ICU time is associated with hospital mortality: A registry analysis of 14,788 patients from six university hospitals in the Netherlands. Crit Care Med. 2019;47(11):1564-71. [PubMed | Google Scholar | DOI]

19. Kobayashi H, Uchino S, Takinami M, Uezono S. The impact of ventilator-associated events in critically ill subjects with prolonged mechanical ventilation. Respir Care. 2017;62(11):1379-86. [PubMed | Google Scholar | DOI]

20. Williams TA, Ho KM, Dobb GJ, Finn JC, Knuiman M, Webb SAR. Effect of length of stay in intensive care unit on hospital and long-term mortality of critically ill adult patients. Br J Anaesth. 2010;104(4)459-64. [PubMed | Google Scholar | DOI]

21. Javali RH, Krishnamoorthy, Patil A, Srinivasarangan M, Suraj, Sriharsha. Comparison of injury severity score, new injury severity score, revised trauma score and trauma and injury severity score for mortality prediction in elderly trauma patient. Indian J Crit Care Med. 2019;23(2):73-7. [PubMed | Google Scholar | DOI]