

Impact on Quality of Patient Care and Procedure Use in the Medical Intensive Care Unit (MICU) Following Reorganisation

D Y H Tai,**FAMS, MRCP (UK), FCCP*, S K Goh,***MBBS, MRCP (UK), M Med*, P C T Eng,****FAMS, M Med (Int Med), FCCP*,
Y T Wang,*****FAMS, M Med (Int Med), FRCP (Edin)*

Abstract

We conducted this retrospective, cohort study to evaluate the quality of patient care and procedure use in the medical intensive care unit (MICU) following reorganisation and staffing by an intensivist. Consecutive admissions to an adult MICU in a university affiliated hospital during two 3-month periods, August to October 1993 (Period 1, $n = 112$) and January to March 1994 (Period 2, $n = 127$) were analysed.

In Period 1, the MICU was run under the open system in which patient care was provided by the individual attending physicians. In Period 2, a resident MICU team led by a trained intensivist took over the medical care from the primary physicians when the patients were admitted to the MICU. The intensivist also vetted MICU admissions and decided on MICU discharge. In addition, there was a resident respiratory therapist to attend to ventilatory care during office hours. After office hours, the care of the MICU was delegated to the on-call team on a rotational basis among the medical departments. This was the semi-closed ICU model.

The patients in the two periods were similar with respect to age, sex, race, source of admission and APACHE II scores. There was improvement in the median ICU length of stay for survivors from 3 days in Period 1, to 2 days in Period 2 ($P = 0.0114$). The relative risk of ICU death in Period 1 compared to Period 2 was 1.23 ($P = 0.286$). There was no significant difference in the use of peritoneal dialysis (5.4% versus 6.3%) and mechanical ventilation (55.4% versus 49.6%). However, utilisation of intra-arterial lines and pulmonary artery catheters increased from 0% in both Periods 1 and 2 to 23.6% and 5.5%, respectively.

Reorganisation of the MICU in Period 2 resulted in reduced length of MICU stay for survivors. Hence, we believe that coverage by a dedicated ICU team and active respiratory care by a respiratory therapist during office hours were beneficial for the care of the critically ill. There was also a noticeable increase in the use of invasive monitoring.

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Introduction

Critical care is costly as it is labour intensive and involves expensive life support technology. In the United States, the intensive care units (ICUs) use about 15% of the total hospital cost or about 1% of the gross national product.¹ Hence, efficient use of ICU services is of utmost importance to health care administrators.

The medical ICU (MICU) was introduced in Singapore in the early 1970s.² The Ministry of Health, Singapore drew up a training programme of 3 years' duration in respiratory medicine (RM)/critical care medicine (CCM) in 1990. This was implemented with

the hope of better delivery of patient care and outcome.

Numerous studies have tried to evaluate mortality, severity of illness, resource consumption and indications for ICU admission or discharge,³⁻¹² but little information exists on how CCM physician affects patient outcome¹³⁻¹⁵ and procedure utilisation.^{13,14} Li et al¹³ compared 463 and 491 patients in a community hospital ICU before and after staffing by CCM physicians respectively. They found a significant improvement in both short-term and long-term outcome in patients with intermediate likelihoods of death. Reynolds et al¹⁴ studied 100 and 112 MICU admissions in a university hospital

* Consultant and Director, Medical Intensive Care Unit

** Senior Registrar

Department of General Medicine

**** Senior Consultant and Head

Department of Respiratory Medicine

Tan Tock Seng Hospital

*** Consultant and Director, Medical Intensive Care Unit

Department of Respiratory and Critical Care Medicine

Singapore General Hospital

Address for Reprints: Dr Dessmon Y H Tai, Department of General Medicine, Tan Tock Seng Hospital, Moulmein Road, Singapore 308433.

for septic shock during two 1-year intervals with and without CCM faculty. They concluded that in-house availability of intensivists was associated with a significantly lower mortality for patients with septic shock. In both these studies,^{13,14} there was no significant difference in the use of life-support interventions but invasive monitoring was utilised more frequently after the ICUs were managed by the intensivists. In a retrospective comparison of 223 and 216 patients in a university hospital MICU for two consecutive years, Brown and Sullivan¹⁵ found that the ICU and hospital mortalities were significantly reduced when the ICU was managed by a trained CCM specialist.

Therefore, we undertook this study to evaluate the quality of patient care and procedure use following reorganisation and staffing with an intensivist in January 1994 in the MICU.

Materials and Methods

This study was conducted in a general 1100-bedded University-affiliated hospital. About 1000 outpatients and 300 emergency cases are seen daily with more than 120 admissions each day.¹⁶ The MICU has 6 beds to manage critically ill patients from the various medical disciplines, namely General Medicine, Respiratory Medicine, Rheumatology, Geriatric Medicine, Neurology and Rehabilitative Medicine. In addition, there are 4 other ICUs—Coronary, Stroke, Neurosurgical and Surgical (General Surgery and Orthopaedics)—for the respective patients.

The records for all MICU admissions from 1 August 1993 to 31 October 1993 (Period 1), and 1 January 1994 to 31 March 1994 (Period 2), and the acute physiology and chronic health evaluation (APACHE) II scores were reviewed retrospectively. When biochemical data were not available, the scores were assumed to be normal. We felt that this might be a reasonable assumption, given the limitation inherent in retrospective APACHE II scoring, as it was not our practice to do investigations which would not be expected to yield useful information based on history and clinical examination. The Glasgow Coma Scale was scored as accurately as possible using information from the case records. MICU admissions during the interim period from November to December 1993 were excluded as the MICU was in the process of being reorganised and was looked after by a pulmonologist before the return of the intensivist.

In Period 1, patients were managed by their primary physicians who were also responsible for general medical inpatients, supervision of a ward resident team and outpatients. The various physicians made individual rounds on their MICU patients and communicated with the MICU resident medical officer on an individual basis. Decisions on admission, management and discharge were made by the primary physicians. After

office-hours, the care of the MICU was delegated to an on-call medical officer under the supervision of a physician-on-call on a rotational basis. This was the open ICU concept.¹⁷

In Period 2, all the MICU admissions during office hours were vetted by the intensivist based on guidelines drawn up and approved by the Hospital Medical Board. The patients were managed by the MICU team which comprised the intensivist, an advanced trainee in RM/CCM and a resident medical officer. The MICU team had access to the consultative service of the other specialists when the need arose. Ward rounds were conducted twice daily for all the MICU patients. Discharge from the MICU was decided by this team. In addition, a respiratory therapist was available to attend to MICU patients during office hours. The respiratory therapist participated in the care of patients on mechanical ventilators. He titrated ventilatory requirements in consultation with the MICU team, and conducted tracheobronchial suction. He also assisted in the intubation and extubation of patients. This was the semi-closed ICU system as after office hours, MICU care was similar to Period 1.

The nursing staff, equipment and physical facilities were the same in the two periods; there was no change in ancillary care elsewhere in the hospital.

Categorical variables were analysed with the χ^2 test. Continuous variables were analysed using the Wilcoxon rank sum test. A value of $P < 0.05$ was considered statistically significant.

Results

In Period 1, 110 patients had 112 ICU admissions, with 2 patients having 1 readmission each. In Period 2, 119 patients had 127 ICU admissions; 6 had 1 readmission each, and 1 had 2 readmissions. In Period 2, 5 patients were declined critical care by the ICU team on grounds of medical futility. The number of patients who were denied ICU admission in Period 1 was unknown as there was no one to vet admissions.

Using ICU admission as the unit of analysis, the baseline patient characteristics in terms of the mean age, sex, race, source of ICU admission and APACHE II score were similar between the two periods (Table I).

The median length of stay in the MICU and hospital is summarised in Table I. The reduced ICU length of stay for the survivors in Period 2 was statistically significant. The relative risk of dying in the ICU in Period 1 compared to Period 2 was 1.23 ($P = 0.286$).

The use of intra-arterial monitoring and pulmonary artery catheterisation increased from 0% to 23.6% and 0% to 5.5% respectively in Period 2. There was no significant change in the utilisation of invasive therapy during the two periods (Table I).

TABLE I: MICU ADMISSION CHARACTERISTICS

	Number (%) of MICU admissions		Significance level
	Period 1 (n = 112)	Period 2 (n = 127)	
Age (years)*	57.2 ± 19.5	57.8 ± 18.2	NS
Sex			
Male	75 (67)	75 (59)	NS
Female	37 (33)	52 (41)	
Race			
Chinese	80 (71.4)	96 (75.6)	NS
Malay	17 (15.2)	21 (16.5)	
Indian	13 (11.6)	6 (4.7)	
Others	2 (1.8)	4 (3.1)	
Source of ICU admission			
Accident & Emergency	43 (38.4)	32 (25.2)	NS
Intra-hospital transfer	66 (58.9)	90 (70.9)	
Other hospitals	3 (2.7)	5 (3.9)	
APACHE II score*			
Survivors	19.6 ± 8.3	19.0 ± 10.2	NS
Non-survivors	15.2 ± 6.3	14.9 ± 8.8	NS
Non-survivors	22.4 ± 8.3	22.7 ± 10.2	NS
Median MICU length of stay (days)			
Survivors	3	2	<i>P</i> = 0.0114
Non-survivors	2		NS
Median hospital length of stay (days)			
Survivors	11	10	NS
Non-survivors	5.5	7	NS
Invasive therapy			
Peritoneal dialysis	6 (5.4)	8 (6.3)	NS
Mechanical ventilator	62(55.4)	63 (49.6)	
Invasive monitoring			
Intra-arterial line	0	30 (23.6)	
Swan Ganz catheter	0	7 (5.5)	

NS: not significant

* Figures expressed as mean ± SD

Discussion

This retrospective analysis suggests that an intensivist who runs a semi-closed ICU and the presence of a resident respiratory therapist may favourably influence the care of critically ill patients. This is consistent with the results of other studies.¹³⁻¹⁵ The length of stay in the ICU and hospital, and the mortality rate also compared favourably with other MICUs in Singapore which were run by non-intensivists.¹⁸⁻²⁰

We also found that the presence of an intensivist correlated with a striking increase in the use of invasive monitoring interventions.¹²⁻¹⁴

The non-use of intra-arterial catheters and pulmonary artery catheters in Period 1 reflected the lack of expertise and the more conservative attitude of the physicians towards invasive manipulation.^{21,22} In Period 2, the frequencies of arterial cannulation and pulmonary artery cannulation were 23.6% and 5.5%, respectively. These

figures were not high in comparison to other quoted figures.^{13,21}

There are a few reasons why improved outcome might be expected in Period 2.

First, there was improved ICU organisation and communication within the MICU team through the establishment of twice daily ward rounds and reviewing all the patients as a team. Rationale and plan of treatment were also discussed. In the open system, the respective attending physicians reviewed their own patients. The only resident medical officer might not be available to follow all the respective physicians who usually did their ward rounds at about the same time in the morning. Therefore, the medical officer might not have an in-depth understanding of all the patients in the MICU.

Second, the training and experience of the intensivist led to more appropriate and timely medical interventions. For example, the intensivist and the MICU team were available during office hours to perform emergency procedures such as endotracheal intubations and tube thoracostomies promptly. In the open ICU model, the resident medical officer might not be experienced enough to deal with all emergencies and the attending physicians had to be called from distant locations like the outpatient clinic or general ward. At times, even anaesthetists had been called from the operating theatres to help difficult intubations.

Third, cardiopulmonary data obtained from pulmonary artery and arterial catheters led to more appropriate therapeutic interventions as the abnormal pathophysiological changes were better defined. For example, the balance between filling pressure and ability of the heart to handle volume load might not be adequately defined by the clinical parameters or the central venous pressure.²³ The measured therapeutic responses based on serial cardiac output measurements before and after administration of colloids, inotropes and diuretics enhanced accuracy of clinical judgement. An ill patient who is cold, pale and vasoconstricted peripherally may have a relatively normal blood pressure in the presence of inadequate cardiac output. Similarly, a good urinary output may be misinterpreted as adequate renal perfusion when the patient has medullary washout and loss of renal concentrating ability resulting in a dilute urine.²³

However, the use of invasive haemodynamic monitoring should be carefully guided by the risk/benefit ratio because of the inherent potential complications and the additional cost entailed.

Fourth, frequent review and titration of respiratory support by the MICU team, coupled with the intensive ventilatory care provided by the resident respiratory therapist led to more rapid weaning of patients from mechanical ventilators.

There are a few limitations in this study. This was a retrospective study and the number of patients in the analysis was small. We could not include a longer period as the MICU was renovated and the number of beds was increased from 6 to 8 about one month later. Retrospective APACHE II scoring was inaccurate, especially with regard to missing data and Glasgow Coma Scale. The presence of a resident respiratory therapist during office hours in Period 2 might also add another confounding factor.

Furthermore, the change in the management system applied only during office hours as after that, the MICU team together with the intensivist and respiratory therapist were not available. The reduction in the level of a variety of services after office hours in both periods such as nursing, radiology and housekeeping might have independently influenced mortality in both periods.¹³ As this was a retrospective study, the number of adverse events and deaths that occurred after office hours could not be accurately studied.

Survival should not be the only end point in the assessment of the quality of care.²⁴ Equally or even more important, is the disability sustained by the patient as a result of inappropriate medical management e.g. hypoxic brain damage as a result of poor airway management. The latter, though, is more difficult to quantify and assess objectively. The psychological, social and the economic impact on the relatives and the patient is just as great, if not greater, than if the patient had died.

The “do-not-resuscitate” (DNR) philosophy should be used judiciously to limit resource utilisation in the hopelessly ill.²⁵⁻²⁹ This will also free the scarce ICU resources for the more deserving patients to utilise. In appropriate circumstances, the DNR decision is essential for humane and ethical patient care^{30,31} when prolonging life is merely tantamount to delaying the process of dying and causing misery to the patient’s relatives. In Period 2, 7 patients had DNR orders on grounds of medical futility.

The facilities and the ratio of nurses to patients in the general wards need to be improved. This is to prevent the attending physicians from burdening the ICU with patients who do not need intensive care but whose doctors feel are “safer in the ICU.”⁷ The introduction of an intermediate care unit as a step-up or step-down resource for the ICU should be considered. This may help to reduce the admission of the “low-risk” patients to the ICU and the medical service case fatality rate by facilitating access to critical care.^{32,33} This is a good alternative to rationing limited ICU resources.

Conclusion

Reorganisation of the MICU into a semi-closed system with a dedicated ICU team led by an intensivist, and the provision of respiratory care by a respiratory therapist

during office hours resulted in reduced MICU length of stay for survivors in Period 2. More intensivists and respiratory therapists need to be trained so that they can extend the ICU coverage to 24 hours a day.

Staffing of the MICU with intensivist was correlated with increased use of invasive monitoring devices.

The results from this retrospective analysis are encouraging. More studies are required to determine how ICU benefits and costs are affected by the closed ICU organisational model staffed by intensivists, increased use of invasive procedures, the availability of respiratory therapists and the judicious execution of DNR orders.

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