

# Discharge Decision-Making by Intensivists on Readmission to the Intensive Care Unit

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Patients readmitted to the intensive care unit (ICU) have a significantly higher mortality rate. The role of intensivists in judging when to discharge patients from the ICU is very important. We undertook this study to evaluate the effect of the intensivists' discharge decision-making on readmission to ICU. The intensivists actively participated in the discharge decision-making, with the discharge guideline taken into consideration, in respect of group 1 patients, but not in respect of group 2. The readmission rate in group 1 was lower than that in group 2. The readmission in patients in each group was associated with higher mortality rates and longer lengths of stay at the ICU. Respiratory failure was the major cause of readmission. In the non-survivors out of the readmitted patients, the Acute Physiology and Chronic Health Evaluation (APACHE) III scores on the initial discharge and readmission, the multiple organ dysfunction syndrome (MODS) scores on the initial admission, discharge and readmission were higher than the corresponding indices in the survivors. We conclude that the readmission rate was lower when intensivists participated in the discharge decision-making, and that APACHE III and MODS scores on the first discharge and readmission were significant prognostic factors in respect of the readmitted patients.

**Key Words:** APACHE III score, discharge decision-making, intensive care unit, intensivist, multiple organ dysfunction syndrome score, readmission, respiratory complications

## INTRODUCTION

The mortality rate in the patients readmitted to

the intensive care unit (ICU) was significantly higher than in the patients who were not readmitted. The readmitted patients also stayed significantly longer in the ICU, which resulted in higher costs.<sup>1-5</sup> Determination of the optimal timing of the ICU discharge with appropriate discharge criteria will be very helpful in reducing the readmission incidence and the length of stay (LOS) in the ICU, and will improve the quality of the ICU care.<sup>2,6-8</sup> One of the most common reasons for the ICU readmission have been reported to be pulmonary problems, including inadequate pulmonary toilet.<sup>3,9</sup> The role of intensivists in judging when to safely discharge patients from the ICU is very important. Unfortunately, only a few studies have investigated the clinical features and prognostic factors of the readmitted patients, and no prospective studies have evaluated expected readmission rate and the patients' outcomes, with intensivists actively involved in such studies. We have performed this study to evaluate the effect of the intensivists' discharge decision-making on the readmission to ICU.

## MATERIALS AND METHODS

The data of group 1 were collected prospectively from patients admitted to 34 beds of two units, the medical-surgical ICUs of Severance Hospital with 1,550 hospital beds, Yonsei University College of Medicine in Korea from August 2001 through July 2002, while the data of group 2 were collected retrospectively from the patients' records admitted to the same two units from August 2000 through July 2001.

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The study was conducted after obtaining approval for it from our institutional review board. Patients <15 years old, renal transplant patients, patients with isolated myocardial ischemia or infarction and brain death patients were excluded from the study. For group 1, the intensivists were involved in the discharge decision-making, and the discharge criteria were applied. The discharge criteria in our study were defined as a stable hemodynamic status, without vasopressors or inotropics infusion, no pulmonary complications with improved chest X-ray findings, SpO<sub>2</sub> > 95% with or without oxygen delivery via the nasal cannula or tracheostomy site and no operative complications in surgical patients. We evaluated the pulmonary function in the patients in group 1, using the Wright spirometer and the inspiratory force meter during the period of weaning from the ventilator support, before and after extubation. If the vital capacity was less than 15 ml/kg or maximal inspiratory force pressure less than -30 cmH<sub>2</sub>O, or the respiratory rate increased more than 25 breaths/min, the deep breathing and expectoration were encouraged to improve the bronchial toilet and to decrease pulmonary complications. For patients whose pulmonary function failed to further improve, an early tracheostomy rather than extubation was recommended.

The readmission rate and reason for it, ICU LOS, Acute Physiology and Chronic Health Evaluation (APACHE) III score<sup>10</sup> and multiple organ dysfunction syndrome (MODS) score<sup>11</sup> of the readmitted patients were evaluated in the groups. The APACHE III and MODS scores of the survivors and non-survivors were compared on the first admission and discharge, and on the second admission and discharge in the readmitted patients. The readmission causes were classified as either a recurrence of the initial disease (if the readmission diagnosis involved the same organ system as at the initial admission) or a new complication (if the readmission diagnosis involved organ systems different from those involved at the initial admission). The reasons for the readmission were categorized into respiratory, septic, cardiac, gastrointestinal, renal diseases and postoperative management.

All the values were expressed as frequency or mean  $\pm$  SD, and the data were analyzed using

SPSS<sup>®</sup> 10.0 (Statistics Package for Social Sciences, Chicago, IL, USA) statistical software. The categorized variables were compared using the Chi-square test, while the continuous variables were evaluated using the unpaired t-test or paired t-test. A *p*-value of < 0.05 was considered to be statistically significant.

## RESULTS

During the period concerned, 1929 patients eligible to group 1 and group 2 were admitted to our hospital. Of these 1929 patients, 334 patients died, and 113 patient were discharged with DNAR (Do not attempt to resuscitate) orders, while the number of patients who required the ICU readmission during the same hospitalization time was 79 (5.3%). The readmission rate in group 1 (3.9%) was lower than that in group 2 (6.5%) (*p* < 0.05). The mortality rate in the readmitted patients was 34.4% in group 1 and 36.2% in group 2, but the difference was not significant between the groups. The mortality rate of the readmitted patients in each group was higher than that of the non-readmitted patients (*p* < 0.05) (Table 1).

In the readmitted patients, 83.5% had recurrence of the initial disease, while 16.5% experienced new complications. The APACHE III and MODS scores of all the readmitted patients on the initial admission reduced significantly on discharge and increased on readmission (*p* < 0.05). However, in the readmitted patients from group 1, the APACHE III and MODS scores on readmission did not differ from the correspondent indices noted on the initial admission (Table 2). Common reasons for readmission were the respiratory disease (n=29; 36.7% of all the readmitted patients), postoperative complications (n=20; 25.3%) and sepsis (n=16; 20.3%) (Table 3). There was no differences in the occurrence of new complications, the interval between 1st discharge and readmission, 1st and 2nd LOS, APACHE III and MODS scores on 1st, 2nd admission and discharge between group 1 and group 2, in non-survivors or survivors after the ICU readmission. When the non-survivors and survivors in all the readmitted patients were compared, the gender, age, occurrence of new complications, interval between

**Table 1.** Demographic and Clinical Differences between Group 1 and Group 2

	Group 1		Group 2	
	Readmitted Patients (n=32)	Non-readmitted Patients (n=958)	Readmitted Patients (n=47)	Non-readmitted Patients (n=892)
Gender (M/F)	21 / 11	618 / 340	28 / 19	571 / 321
Dept (Med/Surg)	15 / 17	418 / 540	27 / 20	445 / 447
Age (years)	57.8 ± 16.3	55.5 ± 15.4	59.5 ± 15.9	55.5 ± 16.7
1st LOS (days)	12.8 ± 17.4	8.8 ± 12.4	9.6 ± 8.4	9.1 ± 12.2
2nd LOS (days)	18.0 ± 18.2*	-	12.9 ± 12.4	-
Interval (days)	11.7 ± 11.5*		17.1 ± 17.8	
<72 hours, No.(%)	10 (45.5)	-	9 (23.7)	-
>72 hours, No.(%)	22 (54.5)	-	38 (76.3)	-
Mortality (%)	34.4 <sup>†</sup>	18.3	36.2 <sup>†</sup>	17.8
Readmission rate (%)	3.9* (32/761)		6.5 (47/721)	

Values of age, 1st LOS, 2nd LOS and interval are mean ± SD. Group 1, group of patients in whom intensivists were involved in the discharge decision making during the period August 2001 - July 2002; Group 2, group of patients in whom intensivists were not involved in the discharge decision making during the period August 2000 - July 2001; Dept (Med/Surg), Department (Medical/Surgical); LOS, length of stay at ICU; Interval, interval between the first discharge from ICU and readmission to ICU. \* $p < 0.05$  vs readmitted patients of group 2, <sup>†</sup> $p < 0.05$  vs non-readmitted patients in each group.

**Table 2.** Comparison of Patients who Required Intensive Care Unit (ICU) Readmission in Group 1 and Group 2

	Group 1 (n=32)	Group 2 (n=47)	Total (n=79)
Problem, No.(%)			
Original <sup>a</sup>	28 (87.5)	38 (80.9)	66 (83.5)
New <sup>b</sup>	4 (12.5)	9 (19.1)	13 (16.5)
APACHE III score			
on 1st admission	42.1 ± 19.2	36.9 ± 18.2	39.2 ± 18.7
on 1st discharge	30.3 ± 13.2*	28.6 ± 14.3*	29.3 ± 13.8*
on 2nd admission	45.0 ± 24.4	51.5 ± 27.7*	48.8 ± 26.5*
on 2nd discharge <sup>c</sup>	27.5 ± 14.8 <sup>†</sup>	28.1 ± 18.2 <sup>†</sup>	27.9 ± 16.7 <sup>†</sup>
MODS score			
on 1st admission	3.9 ± 2.7	3.0 ± 2.7	3.4 ± 2.7
on 1st discharge	2.5 ± 2.2*	2.2 ± 2.3*	2.4 ± 2.3*
on 2nd admission	5.4 ± 3.3	5.3 ± 3.9*	5.4 ± 3.6*
on 2nd discharge <sup>d</sup>	2.7 ± 2.8	1.8 ± 2.5 <sup>†</sup>	2.2 ± 2.6 <sup>†</sup>

Values of APACHE III score and MODS score are mean ± SD. Group 1, group of patients in whom intensivists were involved in the discharge decision making during the period August 2001 - July 2002; Group 2, group of patients in whom intensivists were not involved in the discharge decision making during the period August 2000 - July 2001; APACHE, Acute Physiology and Chronic Health Evaluation; MODS, Multiple-Organ Dysfunction Syndrome. <sup>a</sup>Readmission because of original problems, <sup>b</sup>Readmission due to new complications, <sup>c,d</sup>Except non-survivors in readmitted patients. \* $p < 0.05$  vs APACHE III score or MODS score on 1st admission within each group, <sup>†</sup> $p < 0.05$  vs APACHE III score or MODS score on 2nd admission within each group. There were no significant differences between the groups.

the first discharge and the readmission and 1st and 2nd LOSs were found not statistically different. In the non-survivors of the readmitted patients, APACHE III scores on the initial dis-

charge and the readmission, MODS scores on the initial admission, discharge and readmission were higher than those of the survivors ( $p < 0.05$ ) (Table 4).

**Table 3.** Major Reasons for Readmission in All the Readmitted Patients

Cause	No. of Patients	%
Respiratory	29	36.7
Postoperative	20	25.3
Septic	16	20.3
Cardiac	7	8.9
Gastrointestinal	5	6.3
Renal	1	1.3
Shock	1	1.3

## DISCUSSION

We applied the discharge guideline in making decisions in respect of the group 1 patients of this study. In the group 1 patients with an active intervention by the intensivists resorted to, the readmission rate (3.9%) was much lower than in any other studies<sup>3,12</sup> or in our control group (6.5%). The respiratory disease was the most common cause of the readmission.<sup>3,9</sup> We performed this study with the hypothesis in mind that the

**Table 4.** Comparison of Survivors and Non-survivors in All the Readmitted Patients

	Survivors (n=51)	Non-survivors (n=28)
Gender (M/F)	35 / 16	14 / 14
Dept (Medical/Surgical)	25 / 26	11월 17월
Age (years)	57.7 ± 17.0	60.9 ± 13.8
Problem, No.(%)		
Original <sup>a</sup>	43 (84.3)	23 (82.1)
New <sup>b</sup>	8 (15.7)	5 (17.9)
APACHE III score		
on 1st admission	37.7 ± 20.7	41.4 ± 14.3
on 1st discharge	26.3 ± 13.6*	34.8 ± 12.7
on 2nd admission	36.0 ± 17.1*	73.2 ± 24.1
on 2nd discharge	27.9 ± 16.7	-
MODS score		
on 1st admission	3.0 ± 2.6*	4.2 ± 2.8
on 1st discharge	1.7 ± 1.9*	3.6 ± 2.4
on 2nd admission	3.8 ± 3.1*	8.4 ± 2.4
on 2nd discharge	2.2 ± 2.6	-
1st LOS (days)	10.5 ± 14.0	11.7 ± 10.7
2nd LOS (days)	15.5 ± 16.6	14.0 ± 12.1
Interval (days)	14.7 ± 14.7	15.3 ± 17.7
< 72 hours No. (%)	11 (21.6)	8 (28.6)
> 72 hours No. (%)	40 (78.4)	20 (71.4)

Values of age, APACHE III score, MODS score, 1st LOS, 2nd LOS, and interval are mean ± SD. APACHE, Acute Physiology and Chronic Health Evaluation; MODS, Multiple-Organ Dysfunction Syndrome; LOS, length of stay at ICU; Interval, interval between the first discharge from ICU and readmission to ICU. <sup>a</sup>Readmission because of the original problems, <sup>b</sup>Readmission due to new complications. \* $p < 0.05$  vs non-survivors.

pulmonary function improved by the intensivists might have reduced the severity of the disease in the patients and application of the discharge guideline could decrease the incidence of readmission to the ICU. The deep breathing and expectoration were encouraged in the patients in group 1 at risk for pulmonary complications, recommending early tracheostomy in patients with cerebrovascular accidents or in elderly patients with ineffective expectoration. Although during the study period, the advanced technologies, improved procedures and operations might have had an influence on the rate of readmission, we did not assess those factors.

Discharge from the ICU at the earliest appropriate time would help to control the ICU costs, with appropriate use of the ICU resources.<sup>12</sup> In addition, patients at risk for readmission should be identified in respect of additional critical care.<sup>13</sup> Since the average LOS of the readmitted patients was much longer than that of the non-readmitted patients, the LOS of the readmitted patients can potentially be a major factor in effective management of the limited resources of the ICU.<sup>1,2,4</sup> Our study, in line with other studies, shows that the readmitted patients stayed 3-4 times longer at the ICU than the non-readmitted patients. Thus, the readmitted patients are considered to consume significant amount of the ICU resources.

The ICU readmission rate in the United States has been reported to range between 5% and 13% of discharges.<sup>2,4,5,14</sup> Interest in patients readmitted to the ICU has grown considerably. Unplanned readmissions to the ICU have been associated with the worsening of the patients' original disease, higher hospital costs and poorer outcomes. The mortality rate in the readmitted patients was 5.9 or 7.5 times higher than that in the patients discharged from the ICU who did not require subsequent readmission.<sup>4,5,12,13</sup> In our study, the mortality rate in the readmitted patients (35.4%) was significantly higher than that in the non-readmitted patients (18.1%).

In other studies,<sup>12,13</sup> the APACHE III and MODS scoring systems were not used at the time of discharge, but here, we evaluated the scores for the readmitted patients on discharge as well as on readmission. The readmitted patients had lower APACHE III scores at the time of the initial

discharge, reflecting reduction of the severity of illness, but significantly higher scores on readmission were noted. We noticed that the readmitted patients had had a higher degree of severity of the disease at the time of the second ICU admission. Moreover, MODS scores on discharge were lower than on the initial admission, but the scores on readmission were significantly higher. The MODS results were similar to those of APACHE III. In the readmitted patients of group 1, APACHE III and MODS scores on readmission were not different from those on the initial admission, suggesting a positive impact of the intervention by the intensivists in improving the condition of the patients at the time of readmission as well as lowering the readmission rate. In the non-survivors of the readmitted patients, APACHE III scores on the initial discharge and readmission, MODS scores on the initial admission, discharge, and readmission were higher than those in the survivors. The APACHE III and MODS scores on the first discharge and readmission in addition to MODS scores on the initial admission can be considered significant prognostic factors for the readmitted patients and can be applied as the early discharge criteria.

Most studies have been limited by their small sample size, short study period, lack of the physiologically based severity of the illness data and the heterogeneity of the patients admitted to different types of ICUs.<sup>14</sup> In our study, we selected both the medical and the surgical patients, but patients < 15 years of age, kidney transplant patients, patients with isolated myocardial ischemia or infarction and brain death patients were excluded from the study to reduce the heterogeneity between the control and study groups. We used the prospective case-control method as we could show little difference in age, sex, department, and 1st LOS between the group 1 and group 2 patients.

Unfortunately, our database did not contain the evaluation of the non-readmitted patients, precluding the identification of risk factors for readmission to ICU. Nevertheless, our study shows that the readmitted patients are characterized by higher mortality rates with poor prognosis and that the readmission rate is lower when the intensivists participate in the discharge decision-

making. Also, certain prognostic factors in respect of the readmitted patients were revealed by using both the APACHE III and MODS scores on admission and discharge, which few studies had previously addressed. Understanding of the clinical features of the readmitted patients may be helpful for the intensivists in definition of the discharge criteria. Since our study included patients admitted to the surgical-medical mixed type ICUs, it may fail to generalize all of the various types of ICUs. But the incidence of readmission to the ICU will decrease with an improved quality and efficiency of the ICU care, when the intensivists are actively involved in the discharge decision-making, with application of appropriate discharge criteria.

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