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A nationwide survey of intensive care unit discharge practices

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Abstract *Objective:* To describe intensive care unit (ICU) discharge practices, examine factors associated with physicians' discharge decisions, and explore ICU and hospital characteristics and clinical determinants associated with the discharge process. *Design:* Survey in adult ICUs affiliated with the Swiss Society of Intensive Care Medicine. *Interventions:* Questionnaire inquiring about ICU structure and organization mailed to 73 medical directors. Level of monitoring, intravenous medications, and physiological variables were proposed as elements of discharge decision. Five clinical situations were presented with request to assign a discharge disposition. *Measurements and results:* Fifty-five ICUs participated, representing 75% of adult Swiss ICUs. Responsibility for patient management was assigned in 91% to the ICU team directing patient care. Only 22% of responding centers used written discharge guidelines. One-half of the respondents considered at least 10 of 15 proposed criteria to decide patient discharge. ICUs in central referral hospitals used fewer criteria than community and private hospitals. The availability of intermediate care units was significantly greater in university hospitals. The ICU director's level of experience was not associated with the number of criteria used. In the five clinical scenarios there was wide variation in discharge decision. *Conclusions:* Our data indicate that there is marked heterogeneity in ICUs discharge practices, and that discharge decisions may be influenced by institutional factors. University teaching hospitals had more intermediate care facilities available. Written discharge guidelines were not widely used.

Keywords Intensive care unit · Organization · Questionnaire · Critical care · Human · Practice guidelines

Introduction

Intensive care units (ICUs) are among the most technologically sophisticated and expensive components of the health care delivery system, and they now form an essential part of hospital care. A significant number of research groups are focusing their attention on improving the organization of the ICU and defining its place in the *continuum* of care [1, 2, 3, 4, 5]. In addition, geographical, organizational, and socioeconomic conditions are driving forces determining access to health care resources. The ICU organization (closed or open) [6, 7], the type of physician coverage (full-time intensivist or consulting physician) [8], and the availability of step-down units [9] all markedly influence patient flow patterns through the ICU. Although consensus guidelines for discharge exist [10], very little information is available on local ICU discharge practices. The lack of data is intriguing since it has been reported that mortality after ICU discharge is not negligible, ranging between 6% to 27% [11]. Recent data

suggest that some of these post-ICU deaths are associated with inappropriately early ICU discharge and were therefore potentially preventable [12]. Furthermore, patients requiring readmission to the ICU have not only disproportionately high hospital mortality rates, ranging from 25% to 58% [13, 14], but also prolonged ICU and hospital stay [15, 16, 17].

Nonetheless, establishing discharge criteria is not as simple as determining whether a patient requires a reduced level of care, and many institutional factors may influence this decision. Within any institution a patient must meet both nursing and medical standards to be eligible for ICU discharge [18]. However, very little is known about how physicians make ICU discharge decisions at the individual level. These decisions are complex and are influenced by several factors including perceived prognosis, severity of illness, physician preferences and experience, bed availability, staffing of the normal hospital ward, and the accessibility to lower level care facilities (e.g., intermediate care units) [9, 19].

The aim of the present study was to ascertain the criteria used to decide on patient discharge from Swiss ICUs. Additionally, we investigated whether differences in the discharge criteria depend on the structure and/or organization of the ICU, and on hospital affiliation.

Materials and methods

Census sample and development

The population sample for the study was based on the Swiss Society of Intensive Care Medicine database of all accredited adult ICUs for the year 2002, with a sampling frame of 73 ICUs. All types of ICU, i.e., surgical, medical, and mixed medical-surgical, were included in this voluntary and anonymous survey. For the purpose of the present study the institutions were classified into three groups according to the size and function of their respective hospital [20]: university teaching hospitals (group A; $\geq$600 beds), central referral hospitals (group B; 300–599 beds), and community and private for-profit hospitals (group C; <300 beds). The institutional ethics committee waived the requirement for consent since this was a voluntary anonymous survey.

Survey instrument

A questionnaire composed principally of closed questions was structured in two sections (see Electronic Supplementary Material). The first section was designed specifically to obtain information on the organization and structure of the ICU. The second identified criteria for discharge decision making (process of care) and focused on specific discharge practices including the use of physician-driven discharge protocols, the use of discharge criteria based on the requirement for monitoring devices, nurse-driven discharge criteria (e.g., chest therapy, wound-dressing), intravenous medications, and physiological variables. The evaluation of the discharge process was based on the illustration of five clinical situations (Electronic Supplementary Material)

A motivational letter explaining the aim of the study and emphasizing the importance of completing the questionnaire was mailed to the medical directors of each ICU. To increase the response rate up to three reminders were sent, starting 1 month after the initial correspondence and then monthly until December 2002.

To identify potential ambiguities in the formulation of the questions a pretest was carried out using a selected sample of six senior physicians, all members of the Swiss ICU network, with extensive experience in the practice of intensive care medicine. The pretesting expert group was requested to complete the questionnaire and to provide written feedback regarding items on which they experienced difficulty. All of the comments and suggestions proposed by the expert group were considered. After finalization of the survey questionnaire the instrument was sent to the clinical centers and data collection took place from June to December 2002.

Data collection included the following variables: ICU director's number of years of experience, board certification in intensive care medicine, board certification in other specialties, job position/title, Institutional classification, type of ICU, open or closed ICU unit model ("open," a unit where affiliated physicians can admit patients to the ICU and have primary responsibility for patient's care; "closed," a unit where responsibility for patient management is transferred to the ICU team who directs patient's care), number of beds, number of ICU admissions per year, availability of intermediate care facilities, use of computerized information systems, assessment of nurse work-load, time restrictions on ICU discharge, and a list of discharge decision elements including the physiological variables used in the acute physiological score of the Acute Physiology and Chronic Health Evaluation II severity of illness index [21]. Inconsistencies in data reporting were verified and entry errors were corrected when possible, or the data were recorded as missing.

Statistical analysis

We present several summary measures to describe our results. For univariate summaries frequency tables are used to describe categorical and classification variables; estimated means and standard deviations are used to describe variables of a continuous nature (e.g., ICU admissions/year, average length of stay in the ICU). Bivariate associations are assessed by Pearson's correlation coefficient for continuous variables, κ statistic for categorical variables, and regression analysis for combinations of categorical and continuous variables.

Regression analysis is also used in our multivariable models of association. The primary predictor of interest was type of institution. Our primary aims were to investigate the association between type of institution, the predictor variable (university teaching hospitals, A; central referral hospitals, B; community and private for-profit hospitals, C), and: (a) ICU structure and organization, (b) number of discharge criteria, and (c) the discharge disposition in each clinical situation. We used logistic regression and linear regression to model the above associations. Summary statistics for the linear regression models are mean differences; odds ratios are given for logistic regression models. For each clinical situation Pearson's χ^2 test was used to test for associations where appropriate. In secondary analyses the type of unit (mixed, medical, and surgical) was used as the main exposure of interest. Differences at p values less than 5% were considered statistically significant; all statistical tests are two-tailed. The STATA statistical software, version 7.0 (Stata, College Station, Tex., USA) was used in all analyses.

Results

A total of 55 questionnaires were returned during the 6-month period, providing a 75% response proportion. The proportion of nonrespondents was 22% in group A (uni-

Table 1 ICU director's training and experience (55 responses)

Primary specialty	
Anesthesiology	27 (49%)
Internal medicine	26 (47%)
Surgery	2 (4%)
Board certification in another specialty	
Pulmonary	2 (4%)
Nephrology	1 (2%)
Cardiology	4 (7%)
Infectious disease	1 (2%)
Neurology	1 (2%)
Emergency medicine	1 (2%)
Swiss Board certification in critical care	53 (96%)
Years of experience in critical care (mean, SD)	11.9±8.3

versity teaching hospitals), 20% in group B (central referral hospitals), and 42% in group C hospitals (community and private for-profit hospitals). Stratifying on ICU type, the proportion of nonrespondents was 40% among medical, 33% among surgical, and 24% among mixed ICUs. Training of ICU medical directors is presented in Table 1.

Hospital and ICU structure and organization

The hospital structure and characteristics and the organization of the ICUs are summarized in Table 2. In Switzerland the number of ICU beds per inhabitants is 1/10,000. Characteristics of the ICU patient population are shown in Table 3. Post-ICU mortality was reported by 32 ICU directors. The average post-ICU mortality rate was 5.8±3.7% at hospital discharge, and 6.7±3.7% at 28 days. The majority of the ICUs (75%) defined their caseload as mixed medical and surgical. Intermediate care units were available primarily in university teaching hospitals (77% in teaching vs. 30% in central referral and 23% in community and private hospitals; p=0.01, test of independence, χ^2 with 2 d.f.). In 91% of ICUs the responsibility for patient management was transferred to the ICU team who directed patient's care, and only the ICU medical team was authorized to write orders ("closed unit" model).

Discharge criteria

Criteria precluding patient's discharge and their distribution by hospital type are presented in Table 4. Only a small proportion of the responding centers (22%) reported using written guidelines for discharging patients from the ICU. In most of the ICUs the administration of intravenous vasoactive medications did not allow ICU discharge (Table 4). One-half of the respondents indicated to consider at least ten criteria to decide on transfer from the ICU. There was a significant association between the number of criteria used and the type of institution, with central referral hospitals reporting using on average two fewer criteria (mean difference 2.5, 95% CI 4.69–0.31, p=0.026) than community and private hospitals. However, teaching hospitals reported a number of criteria not different from community and private hospitals (difference 0.83, 95% CI, 3.56–1.92, p=0.55).

Table 2 Structure and organization of the responding hospitals (55 responses)

Hospital affiliation	
University teaching hospitals	9 (16%)
Central referral hospitals	20 (36%)
Community and private-for-profit hospitals	26 (47%)
Type of ICU	
Mixed	41 (75%)
Surgical[a]	9 (16%)
Medical	5 (9%)
Number of available ICU beds	10.2±5.4
ICU bed occupancy rate	82.7±11
Average ICU length of stay (days)	2.8
Number of ICU admissions per year	
Mean±SD	1166±621
Median (range)	1000 (400–3500)
Restrictions on schedule for ICU discharge	13 (24%)
Intermediate care unit (IMCU)	19 (35%)
IMCU hospital affiliation	
University teaching hospitals	7/9 (78%)*
Central referral hospitals	6/20 (30%)
Community and private for profit hospitals	6/26 (22%)
Total number of IMCU-beds (n=17)	137
Mean±SD	8.6±9.4
Median (range)	5 (2–40)
Ratio of IMCU-beds to ICU-beds for hospitals with IMCUs	137/215 (0.6)
ICU nurse to patient ratio during daytime shifts	0.7±0.2
ICU nurse to patient ratio during nighttime shifts	0.6±0.3
Presence of computerized information systems	
Hospital	30 (55%)
ICU	41 (75%)

*p=0.01, test of independence between hospital type and affiliation
[a] Neurosurgical 2%, burn 2%

Table 3 Characteristics of the ICU patient population (46 responses)

Patients receiving mechanical ventilation	30%
Mean length of mechanical ventilation (days)	4.3
Level of nurse workload[a]	
Very intense (IA)	5 (11%)
Intense (IB)	14 (31%)
Intermediate (II)	18 (40%)
Moderate (III)	9 (18%)
ICU patient-days in 2002	239,131
Outcome	
ICU mortality	4.6±2.2
Hospital mortality	5.8±3.7
28-day mortality	6.7±3.7
ICU readmission rates	
≤5%	37 (81%)
5–10%	5 (11%)
>25	0
Unknown	4 (8%)

[a] Classification according to the Swiss Society of Intensive Care Medicine classification (http://www.swiss-icu.ch/USI_IPS_2004.pdf); nurse to patient ratio/shift: IA, 4/3; IB, 3/3; II, 2/3; III, 1/3

Table 4 Frequency of the criteria evaluated in the decision to discharge patients from the ICU (55 responses) (*Group A* university teaching hospitals, *Group B* central referral hospitals, *Group C* community and private for-profit hospitals)

	Group A (*n*=9)		Group B (*n*=20)		Group C (*n*=26)		All (*n*=55)	
	n	%	*n*	*n*	%	%	*n*	%
Use of guidelines for discharge	2	22	4	20	6	23	12	22
Criteria for discharge								
Arterial oxygenation	9	100	20	100	23	88	52	95
Vasoconstrictors or inotropics	9	100	18	90	24	92	51	93
Heart rate	8	89	19	95	21	81	48	87
Respiratory rate	8	89	18	90	22	85	48	87
Mean arterial pressure >65 mmHg	8	89	19	95	22	85	49	89
Glasgow Coma Scale	7	78	16	80	23	88	46	84
$PaCO_2$	7	78	16	80	23	88	46	84
pH	7	78	11	55	20	77	38	69
Potassium	5	56	9	45	15	58	29	53
Body temperature	6	67	9	45	12	46	27	49
Renal replacement therapy	6	67	9	45	11	42	26	47
Sodium	4	44	6	32	10	38	20	36
Creatinine	4	44	5	25	11	42	20	36
Hematocrit	4	44	3	15	10	38	17	31
White blood cell count	4	44	3	15	7	27	14	25
Use of multiple criteria[a]								
≤5 criteria	1	11	1	5	3	12	3	5
6–10 criteria	2	22	14	70	9	35	25	45
11–15 criteria	6	66	3	15	11	38	19	35
>15 criteria	0	–	2	10	4	15	6	11
Application of nursing discharge criteria	3	33	11	55	13	50	29	53
Nursing discharge criteria[a]								
Respiratory therapy	3	33	8	40	11	42	24	44
Wound dressing	1	11	2	10	5	19	8	15
Nursing workload indices	2	22	5	25	3	11	10	18
Agitation	1	11	0	–	1	4	2	4
Understaffing in the general ward	1	11	0	–	0	–	1	2
Intravenous medications that contraindicate the transfer[b]								
Catecholamines	9	100	19	95	21	80	49	89
Vasodilators	7	77	17	85	19	73	43	78
β_2-Stimulants	5	55	15	75	15	58	35	64
Antiarrhythmic drugs	6	66	12	60	12	42	30	54

[a] Criteria selection was not mutually exclusive: multiple entries were allowed; numbers do not add up to 100% because of missing data
[b] Continuous intravenous use

There were no differences in the number of criteria used for discharge among medical, surgical, and mixed units (difference 1.97, 95% CI 5.60–1.65, p=0.28 for surgical vs. mixed; 0.86, 95% CI 2.90–2.73, p=0.95 for medical vs. mixed). There was no association between open and closed units and the number of criteria used (mean difference between closed vs. open units: 0.004, 95% CI 4.01–4.02, p=0.99).

Clinical situations

Table 5 presents the results of the five clinical case descriptions inquiring about eligibility for discharge from adult ICUs. For each clinical picture the respondents were asked to assign a discharge disposition. In clinical situation no. 1 the odds for a patient of remaining in the ICU were higher in patients hospitalized in community and private hospitals than in university teaching hospitals (p=0.028, logistic regression). In the other four clinical situations the likelihood of remaining in the ICU or being transferred to an intermediate care unit or to a general ward was the same in the different levels of hospital (Table 5). Overall, although the agreement among respondents exceeded chance, there was lack of consensus with regard to preferences of patient disposition (κ=0.035, p<0.01).

Discussion

The purpose of the current study was to determine the characteristics of and the variation in the structure and organization of Swiss ICUs and the process implemented to discharge patients from the ICU. In Switzerland the majority of ICUs are of the "closed" type, with specialists

Table 5 Distribution of the responses for the five clinical situations of discharge from adult ICUs. Responders were asked to indicate their discharge disposition. *Clinical situation no. 1*: history of chronic obstructive pulmonary disease, 48 h postextubation, tracheal suctioning 6–8/day, PaO_2/FIO_2 ratio $\geq$200 mmHg; *clinical situation no. 2*: neurological condition with admission Glasgow Coma Score 10, same-day tracheotomy and stable arterial blood pressure; *clinical situation no. 3*: thoracic trauma with flail chest, PCA infusion to control analgesia, PaO_2/FIO_2 ratio: $\geq$200 mmHg; *clinical situation no. 4*: triage situation (*n*=52), history of alcohol abuse, septic shock with multiple organ failure, no requirement for vasoconstrictors for 6 h, no bed availability in the ICU, a new patient with myocardial infarction is announced; *clinical situation no. 5:* administrative situation (*n*=51), cardiogenic shock after myocardial infarction, no requirement for dobutamine, urine output: 40 ml/h, patient with private insurance, situation occurs on a week-end. Data are stratified based on the availability of intermediate care units (*yes* IMCU available, *no* IMCU not available) (*Group A* university teaching hospitals, *Group B* central referral hospitals, *Group C* community and private for-profit hospitals)

Intermediate care unit (IMCU)	Group A				Group B				Group C				All (*n*=36)	
	Yes (*n*=7)		No (*n*=2)		Yes (*n*=6)		No (*n*=14)		Yes (*n*=6)		No (*n*=20)			
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Clinical situation no. 1														
Patient stays in the ICU	0	–	0	–	0	–	4	29	2	40	7	39	13	26
Patient transferred from ICU[b]	4	100	2	100	6	100	10	71	3	60	11	61	36	74
Clinical situation no. 2														
Patient stays in the ICU	2	40	0	–	1	17	5	36	2	40	7	39	17	34
Patient transferred from ICU[b]	3	60	2	100	5	83	9	64	3	60	11	61	33	66
Clinical situation no. 3														
Patient stays in the ICU	2	50	0	–	0	–	3	21	1	25	6	35	12	26
Patient transferred from ICU[b]	2	50	2	100	6	100	11	79	3	75	11	65	36	74
Clinical situation no. 4														
Patient stays in the ICU	1	25	0	–	2	33	3	21	1	20	6	33	13	27
Patient transferred from ICU[b]	3	75	2	100	4	67	11	79	4	80	12	67	36	73
Clinical situation no. 5														
Patient stays in the ICU	2	50	1	50	5	83	7	50	1	25	10	56	26	54
Patient transferred from ICU[b]	2	50	1	50	1	17	7	50	3	75	8	44	23	46

[a] Overall agreement among respondents κ=0.035, p<0.01
[b] Patient transferred to either intermediate care unit or general ward

trained in intensive care assuming full responsibility for patient care. Despite the recommendations proposed by the American Society of Critical Care Medicine only a minority of the responding ICUs (22%) use written discharge guidelines. The lack of agreement in the responses to the clinical situations indicated considerable heterogeneity of discharge practices among the ICUs surveyed. The variation in the responses to the clinical scenarios may indicate that written criteria for discharge from intensive care are of limited value without bedside evaluation of individual patients by an experienced clinician. However, the approach to patient discharge was affected principally by factors independent of patient's condition. For example, in clinical situation no. 1 none of the responders from university teaching hospitals indicated that they would keep the patient in the ICU, whereas 40% of the responders from community hospitals would continue monitoring the patient in the ICU. A possible explanation for these differences in discharge practices is the greater availability of intermediate care units in larger hospitals. There may also be differences in training and experience between the general ward personnel and ICU caregivers. However, our survey did not find significant differences in ICU directors' level of training between different institutions. With 25% missing data from our census, we believe that the responses from directors who did not respond to the survey would not have differed significantly from those directors who did participate.

The current survey does not address the ICU case mix at the individual level, but the large number of and variability in participating ICUs allows generalization regarding ICUs with different structures and organization.

It is accepted that discharge to a lower level of care is appropriate if: (a) a patient's physiological status is stabilized, and the need for ICU monitoring and care is no longer required; and (b) no further active interventions are planned [10]. Moreover, discharge criteria from critical care units should reflect the admitting criteria to the next level of care [22]. It has been shown that patients discharged at night and with elevated discharge Therapeutic Intervention Scoring System scores had higher post-ICU mortality [19, 23]. Furthermore, increased pressure for ICU beds may also result in premature discharge and contribute to increase post-ICU hospital mortality [24, 25]. However, a recent study found no association between the time of discharge from the ICU and subsequent hospital mortality [11]. Interestingly, almost none of the surveyed ICUs restricted the ability to discharge patients around the clock both on weekdays and on weekends (data not shown).

In recent years there has been an increased focus on outcome after intensive care [26], and scores for pre-

dicting outcome have been validated [27]. Careful neurological assessment, meticulous attention to respiratory transfer orders, and prompt respiratory therapy in the general ward may significantly decrease the need for early readmission to the ICU. The effectiveness of follow-up by critical care outreach services ("ICU beyond the wall") after discharge from the ICU has been recently shown [28, 29]. These studies suggest that outreach intervention improves in-hospital mortality and survival to discharge from hospital and significantly decreases readmission to the ICU. Daly et al. [4] found evidence that keeping at-risk patients in the ICU for additional 48 h reduces post-ICU mortality by 39%, using a triage discharge model. Whether the respondents took these considerations into account could not be determined in our survey.

The provision of more high-dependency units has been proposed by many authors to minimize the number of preventable deaths after ICU discharge [12, 24, 25]. In this context the utilization of intermediate care units or the use of "hot zones" in the ward for patients not requiring a high level of care and the creation of "cold zones" in the ICU are important issues [2].

The present survey is an initial step in collecting information on organization, structure, performance, and outcomes of ICUs in a broad spectrum of settings. Whether these findings are generalizable to other countries cannot be addressed in this study. However, data from previous ICU surveys indicate wide variability in ICU practices. Our data suggest that there is room for improvement in the standardization of safe ICU discharge practices. Whether the presence of intermediate care facilities unloads ICU bed occupancy and efficiently reduces ICU utilization and overall costs needs to be determined. In particular, objective admission and discharge criteria for each type of ICU should be developed. Defining explicit ICU discharge criteria is important to interpret and compare studies evaluating ICU mortality and length of stay as outcome measures. Differences in discharge practices as well as referral patterns among ICUs participating in clinical trials may lead to bias in the interpretation of the results. For example, premature ICU discharge may artificially reduce ICU mortality without decreasing hospital mortality [30] and may also affect ICU length of stay.

Conclusions

Our findings demonstrate marked heterogeneity and lack of consensus regarding discharge decisions among the 55 Swiss ICUs surveyed. Written discharge guidelines are not widely used. University teaching hospitals had more intermediate care facilities available. Larger hospitals use fewer criteria when deciding to discharge a patient from the ICU. Implementation of discharge guidelines may be helpful in daily critical care practice and should be part of overall clinical plan. Establishment of objective discharge criteria is critical for performance evaluation and the understanding of clinical trials or outcomes studies

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