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Proxy-perceived prior health status and hospital outcome among the critically ill: is there any relationship?

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Abstract *Objectives*: To measure the health status of critically ill patients prior to hospital admission and to study the relationship between prior health status (PHS) and hospital mortality.
Design: 523 patients admitted to the intensive care department from October 1994 to June 1995 were included consecutively in the study. Health status 3 months prior to admission was assessed retrospectively by proxies using the EuroQol 5D (EQ-5D) and the Karnofsky Performance Status Scale (KF). Patients were classified into four admission categories: trauma injury, scheduled surgery, unscheduled surgery and other medical conditions.
Setting: Department of Intensive Medicine, University Hospital of Bellvitge, Barcelona, Spain.
Patients: 84 trauma injury patients, 239 scheduled surgery patients, 57 unscheduled surgery patients and 143 patients with other medical conditions.
Interventions: The descriptive system and visual analogue scale (VAS) of the EQ-5D and the K.F.
Measurements and main results: Using proxy responses we found that trauma injury patients had the best PHS and scheduled surgery patients the worst. There were statistically significant differences in mean VAS scores and all EQ-5D dimensions, except self-care, when trauma injury patients or scheduled surgery patients were compared with the other admission categories. No significant differences were found on these variables between unscheduled surgery patients and medical patients. We found no statistically significant differences in PHS health status between patients who died and those who survived, either within each admission category or in the sample as a whole.
Conclusions: The PHS of critically ill patients varied according to admission category. Given the instruments used and population studied, there was no association between PHS and hospital outcome.

Key words EuroQol · Karnofsky · Health status · Quality of life · Hospital mortality · Critical care patients

Introduction

In recent years, there has been growing interest in the study of health status and health related quality of life among survivors of critical illness (1–9). These studies have shown that health status prior to the onset of the critical illness was the variable which most influenced post-intervention health status. Nevertheless, few studies have analysed the relationship between prior health status (PHS) and hospital mortality among critically ill patients (4–6), and no studies have used self-perceived health-related quality of life measures to assess PHS.

Severity scoring systems (10–13) which aimed to predict hospital mortality among critically ill patients generally included the presence of chronic illnesses and functional status among the predictor variables. In later studies carried out to improve the predictive ability of the severity scoring systems (14–16), PHS was found to be of lesser importance in hospital mortality prediction. However, no variables of self-perceived health status were included in these scoring systems.

Obtaining data on the PHS of critically ill patients is nevertheless difficult, due to the problems associated with administering questionnaires to such patients. One possible solution is to obtain the information by means of a proxy response. In an earlier study (17), we observed that the EuroQol 5D could be reliably used with proxies to determine the health status of patients prior to admission to the intensive care unit (ICU).

The aims of this study were: 1) to measure the PHS of critically ill patients prior to hospital admission; and 2) to study the relationship between the patient's PHS and hospital mortality.

Patients and methods

All patients admitted to the ICU of the University Hospital of Bellvitge in L'Hospitalet, Barcelona between October 1994 and June 1995 were included consecutively in the study. Post-operative patients following scheduled heart surgery were only included from October 1994 to February 1995. Those patients for whom a proxy response could not be obtained, and patients who were admitted to the ICU for less than 12 h, were excluded from the study. Additionally, if a patient was readmitted during the study period, only the data obtained at the first admission was used.

Permission to carry out the study was obtained from the Ethics Committee of the University Hospital of Bellvitge.

The ICU consists of 24 beds divided into two main units, as well as 9 beds in a step-down unit, which only admits patients from the main units. The ICU provides care for all post-operative heart surgery patients and heart or liver transplant patients, as well as critical medical or surgical patients from the hospital wards, emergency room and from two post-surgical recovery units. The latter two units are open 24 h a day and only transfer those patients suffering from acute complications to the ICU. Non-surgical critical cardiac patients are admitted to a separate coronary unit.

Data collection

The data were collected by four experienced intensive care doctors (AD, MG, HT, EF). Data collected on patients included socio-demographic information: age, gender and level of education, the dates of admission to, and discharge from the hospital and the ICU. Clinical data were also collected and included main diagnosis, location prior to admission to the ICU (i.e. emergency room, hospital ward, operating room, recovery unit or other hospital) and all necessary variables for calculating the mortality probability model MPMo on admission (15) and the simplified Acute Physiology (SAPS) II (16). Data collected on proxies included age, gender and relationship to the patient. A proxy was defined as a person who had lived with the patient for at least the previous 3 years or someone close to the patient who had known him on her for the same period of time (17).

Patients were grouped into four admission categories based on their diagnosis on hospital admission: (1) Traumatic injury, regardless of whether they underwent surgery or not; (2) scheduled surgery, when the decision to operate had been made more than 24 h prior to surgery; (3) Unscheduled surgery, when surgery had to be carried out less than 24 hours after the medical decision to operate; (4) Medical pathologies; all patients who could not be classified in one of the previous groups. Patients in admission categories 2 and 3 were only regarded as surgical if the decision to operate was made within 7 days prior to ICU admission.

Health status measurement

The EuroQol 5D (EQ-5D) and Karnofsky Performance Status Scale (KF) were used to assess patients' health-related quality of life and functional status respectively (18, 19), at a point 3 months prior to hospital admission. The EQ-5D is a simple non-disease specific instrument consisting of two main parts. The first part is descriptive, consisting of five dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression) with three possible levels of severity in each dimension (1 = no problems, 2 = some/moderate problems, 3 = very severe problems). Respondents are asked to check one level in each dimension. The second part is a visual analogue scale (VAS) on which the individual rates his or her overall health on a scale of 0–100, where 0 represents the worst imaginable health state and 100 the best imaginable health state. The questionnaire can be self- or interviewer-administered.

The KF was designed to be completed by one observer (20, 21). It consists of 11 items in an ordinal scale ranging from 0 to 100 which correspond to different levels of functional status. A score of 100 means that the patient is free of signs or symptoms of illness, while 0 represents death. Four categories of patients were established a priori according to their scores on the KF: patients scoring 100 had no signs or symptoms of illness and were able to function normally; patients scoring 80–90 had signs or symptoms of illness, but able to function normally; patients scoring 50–70 were patients with various degrees of incapacity, but who were able to live independently and look after themselves; patients scoring 10–40 were unable to look after themselves, required special care or hospitalization, and the illness might progress rapidly.

Proxies completed the EQ-5D questionnaire when the patient was admitted to the ICU. Standardized instructions were designed to help the proxy recall the patient's health status prior to hospital admission. These instructions were as follows: "Think of your relative or friend and check the statements that best describe his or her health state 3 months prior to the current hospital admission". Patients completed the questionnaire if and when their health state permitted it. In all cases, the EQ-5D was administered by the doctor attending the patient. The attending physician completed the KF questionnaire when the patient was admitted to the ICU. The attending clinician also made a subjective evaluation of the patient's cognitive ability to ensure that the or she was capable of answering the questionnaire, and ensured that the patient had not been administered sedatives.

If the patient was discharged from the hospital without being able to respond to the questionnaire, the patient was categorized as being "unable to answer".

Table 1 Socio-demographic and clinical variables by admission category groups (*LPA* location prior to admission, *LOS* length of stay in ICD, *SMR* standardized mortality ratio, *CI* 95 % confidence interval)

	Trauma	Scheduled	Unscheduled	Medical	All
No. of patients	84	239	57	143	523
Male (%)	82	66	63	64	67.5
Low level of education (%)	56	81	88	84	78
LPA (%)					
Operating theatre	2	82	26	0	41
Recovery units	93	17	63	43	42
Other	5	1	11	57	17
Age (mean ± SE)*	41 ± 1.6	59 ± 0.9	63 ± 1.9	53 ± 1.2	55 ± 0.7
SAPS II (mean ± SE)*	34 ± 1.3	28 ± 0.8	47 ± 1.6	39 ± 1.0	34 ± 0.6
LOS (mean ± SE)*	19 ± 1.9	11 ± 1.1	21 ± 2.4	14 ± 1.5	14 ± 0.8
No of deaths	15	41	34	58	148
Hospital mortality (%)**	18	17	60	41	28
SAPS SMR (CI)	0.85 (0.80–0.89)	1.43 (1.41–1.44)	1.48 (1.42–1.53)	1.44 (1.40–1.48)	1.35 (1.33–1.36)
MPM SMR (CI)	0.65 (0.60–0.70)	1.31 (1.29–1.32)	1.41 (1.34–1.47)	1.40 (1.36–1.44)	1.23 (1.21–1.25)

Statistically significant differences: * ANOVA $p < 0.001$; ** chi-square $p < 0.001$

Statistical analysis

Descriptive statistics and frequencies were determined in each admission category group for all primary variables: age, sex, level of education, location prior to admission, SAPS II, length of stay and mortality. Comparisons between admission groups were carried out using analysis of variance, followed by Student's t-test for pairwise comparisons and chi-square for categorial variables.

Unweighted kappa statistics were calculated to examine agreement between patient and proxy responses on EQ-5D dimensions. Patient/proxy agreement on the VAS was calculated using the intraclass correlation coefficient (ICC) and confidence intervals (CI) (22).

The estimated probability of death was calculated for each patient in accordance with the MPM and SAPS II equations (15, 16). The standardized mortality ratio (SMR) according to admission category was obtained for each group and for the overall study population. Calibration analysis was performed using the Hosmer-Lemeshow Goodness of Fit test (23), in order to analyze the effect of location prior to admission on the relationship between estimated probability of death and actual mortality, as it has been shown that the inclusion of patients from other units can produce an unrealistical estimated mortality (24).

PHS measurements were compared across admission categories and between survivors and non-survivors in each admission category individually and for the overall sample. Categorical variables were compared using the chi-square test; Student's t-test and the Mann-Whitney U test were used for continuous variables.

A logistic regression analysis was performed to determine which variables were most highly correlated with mortality. The dependent variable was hospital mortality, and the independent variables tested were gender, age, admission category, location prior to ICU admission, level of education, scores on EQ-5D dimensions, VAS scores, KF groups and SAPS II. As the SAPS II score explains such a large amount of the variance in this analysis, it can obscure the explanatory effect of other variables. For that reason, two regression analyses were performed, in which the SAPS II score was first included and then excluded as an independent variable.

Values of $p < 0.01$ were regarded as statistically significant in order to adjust for multiple comparisons (25).

Results

During the study period, data were collected from 550 admissions to the ICU corresponding to 538 patients. Proxy responses could not be obtained for 13 patients (2.4 %) and 2 patients (0.4 %) were admitted for less than 12 h. The final sample therefore consisted of 523 patients whose socio-demographic and clinical characteristics are shown in Table 1 according to admission category. The majority of patients were transferred to the ICU from the operating room and recovery units, except for patients with medical conditions, who were generally transferred from wards or the emergency room. Compared with other groups, trauma injury patients were predominantly young, highly educated males who had generally been transferred from the recovery unit. Unscheduled patients had the highest hospital mortality ($p < 0.01$), while scheduled surgery patients had the lowest SAPS and LOS ($p < 0.01$).

Of the 523 patients studied, 375 (72 %) were discharged alive from the hospital. Forty-five patients discharged alive were unable to answer the EQ-5D questionnaire due to poor cognitive ability. Altogether, 350 patients (67 % of the overall sample) were interviewed in order to assess their health status 3 months prior to their admission to the hospital; 20 of these later died in the hospital. Of proxies interviewed, 156 (30 %) were male and 367 (70 %) were female (mean age 47 ± 15 years). Proxy relationships with patients were as follows: 280 (54 %) were couples, 49 (9 %) were parents, 117 (22 %) were sons/daughters, 63 (12 %) were other relatives and 14 (3 %) were friends; 439 (84 %) proxies lived with the patient and 84 (16 %) did not.

Table 2 Proxy ratings of patients' prior health status by admission category groups. Values are number (%) of patients

	Trauma[a] (n = 84)	Scheduled (n = 239)	Unscheduled (n = 57)	Medical (n = 143)
Mobility				
Without problems	81 (96)	115 (48)	37 (65)	102 (71)
Moderate problems	3 (4)	123 (51.5)	19 (33)	38 (27)
Confined to bed	0 (0)	1 (0.5)	1 (2)	3 (2)
Self-care				
Without problems	81 (96)	211 (88)	51 (89)	122 (85)
Moderate problems	3 (4)	23 (10)	4 (7)	17 (12)
Very severe problems	0 (0)	5 (2)	2 (4)	4 (3)
Usual activities				
Without problems	79 (94)	104 (44)	41 (72)	90 (63)
Moderate problems	5 (6)	85 (36)	12 (21)	34 (24)
Very severe problems	0 (0)	50 (20)	4 (7)	19 (13)
Pain/discomfort				
Without	71 (85)	73 (31)	27 (47.5)	75 (53)
Moderate	12 (14)	130 (54)	23 (40.5)	56 (39)
Very severe	1 (1)	36 (15)	7 (12)	12 (8)
Anxiety/depression				
Without	70 (84)	118 (49)	34 (60)	74 (52)
Moderate	12 (14)	87 (37)	18 (32)	43 (30)
Very severe	2 (2)	34 (14)	5 (8)	26 (18)
Mean (± SE) VAS score	92 ± 2.3	59 ± 1.4	75 ± 2.9	70 ± 1.8
Karnofsky groups				
100	63 (75)	15 (6)	15 (26)	34 (24)
90–80	20 (24)	85 (36)	28 (49)	53 (37)
70–50	1 (1)	124 (52)	12 (21)	48 (34)
40–10	0	15 (6)	2 (4)	8 (5)

[a] According to the test described in the methods section, all differences between trauma injury patients or scheduled patients and each of the other three groups were statistically significant except differences in self-care. No statistically significant differences were found between unscheduled patients and medical patients

Agreement between proxy and patient responses

As in a previous study (17), and in accordance with Fleiss rules (22), we observed a fair to moderate agreement between patient and proxy responses on EQ-5D dimensions. Kappas were 0.52 for mobility, 0.54 for self-care, 0.59 for usual activities, 0.39 for pain/discomfort and 0.31 for anxiety/depression. Agreement between responses was not affected by the type of patient/proxy relationship, nor by level of education or admission category (data not shown). The comparison of self-evaluated and proxy-evaluated PHS showed very minor differences and no systematic bias. The proxies tended slightly to overestimate problems on functional dimensions and slightly underestimate problems on the pain and mood dimensions.

EQ-5D VAS scores obtained from patients and proxies correlated well (ICC coeficient: 0.72 with 95% CI: 0.68–0.78). Given the need for data on the PHS of patients who were unable to complete the questionnaire, and taking into account the degree of agreement between patient and proxy responses, only proxy responses to the EQ-5D were used in the analysis of results.

PHS by admission category groups

Table 2 shows patient PHS by admission category. Trauma injury patients reported the fewest problems on EQ-5D dimensions, the highest VAS scores, and the highest level of functional status, indicating better PHS 3 months prior to hospital admission than that of other groups. Scheduled surgery patients had the worst PHS 3 months prior to admission ($p < 0.01$). Analysis showed a strong positive correlation between scores on the KF and the EQ-5D: in other words, better functional status correlated positively with better health-related quality of life (data not shown).

Analysis of estimated versus predicted mortality

Hospital mortality was used as an indicator of ICU effectiveness for the four admission categories. SMRs indicated that observed mortality was higher than expected for all groups except trauma patients. Calibration analysis of the whole sample using the goodness of fit for SAPS II gave poor results (Hg = 30.74; C = 43.93, $df = 8$, $p < 0.01$). However, when patients were divided into two groups according to whether they came from recovery units or not, we observed that the former adjusted badly with the model (Hg = 42.61, C = 21.1,

Table 3 A comparison of proxy-rated prior health status in surviving *S* and non-surviving *D* patients by admission category. EQ-5D levels are grouped into two categories: 1, without problems, 2, with problems[a]

	Trauma		Scheduled		Unscheduled		Medical		All	
	S	D	S	D	S	D	S	D	S	D
No. of patients	69	15	198	41	23	34	85	58	375	148
Self-description of health state (%)										
Mobility										
1	96	100	48	49	74	59	69	74	63	66
2	4	0	52	51	26	41	31	26	37	34
Self-care										
1	96	100	88	88	96	85	85	86	89	88
2	4	0	12	12	4	15	15	14	11	12
Usual activities										
1	96	87	42	49	83	65	64	62	60	62
2	4	13	58	51	17	35	36	38	40	38
Pain/discomfort										
1	84	87	30	34	52	44	56	47	47	47
2	16	13	70	66	48	56	44	53	53	53
Anxiety/depression										
1	86	73	49	49	70	53	49	55	57	55
2	14	27	51	51	30	47	51	45	43	45
Mean (± SE) VAS score										
	92 ± 1.6	89 ± 4.1	58 ± 1.5	65 ± 3.8	78 ± 3.9	73 ± 3.8	71 ± 2.6	68 ± 3.1	69 ± 1.3	70 ± 1.9
Karnofsky groups (%)										
100	76	73	6	10	26	26	25	19	24	24
90–80	23	27	35	39	66	38	35	42	34	38
70–50	1	0	54	39	4	32	35	32	37	30
40–10	0	0	5	12	4	3	5	7	4	7

[a] According to the test described in the methods section, there were no statistically significant differences between surviving and non-surviving patients in each admission category, nor between surviving and non-surviving patients in the overall sample

$df = 8$, $p < 0.01$), and the latter fitted within the model (Hg = 10.41, C = 3.28, $df = 8$, NS). Similar results were obtained with the MPM.

Relationship between PHS and mortality

Table 3 shows the percentages of survivors and non-survivors in each admission category and for the overall sample. For the sample as a whole, there were no statistically significant differences in PHS between survivors and non-survivors, irrespective of the dimension or instrument (EQ-5D, KF) used to assess PHS. Likewise, when patients were stratified on the basis of illness severity as measured by SAPS II or the MPM there were no statistically significant differences in PHS between survivors and non-survivors.

However, when the results from trauma, unscheduled and medical category groups were aggregated (n = 284), we found significant differences in PHS as measured by the EQ-5D VAS between surviving and non-surviving patients (mean ± SE VAS scores of 80 ± 1.7 and 72 ± 2.2 respectively with $p < 0.01$). On controlling for age, it was found that this trend was maintained, but that statistical significance was lost.

Logistic regression analysis (Table 4) showed that, when the SAPS II variable was excluded, the variables which most consistently predicted hospital mortality were admission category, age and location prior to ICU admission. For the overall sample, EQ-5D and KF variables were found to be non-predicitive of mortality. When the SAPS II variable was included in the analysis it was the most consistent predictor of hospital mortality.

Discussion

The results of the present study show that the PHS of critically ill patients as measured by EQ-5D and KF differs across admission category groups, with trauma patients having the best PHS and scheduled surgery patients the worst. When PHS and mortality are analysed for the sample as a whole, there appears to be no relationship.

The survival of critically ill patients depends on other factors such as age, severity of illness and diagnosis, and PHS might have only a small influence on outcome. Pre-

Table 4 Maximum likelihood estimates of hospital mortality predictor. Two models: without SAPS II or with SAPS II (*LPA* location prior to admission: recovery unit or other)

Variable[a]	β	SE	Sig.	Odds ratio	95% CI
Analysis without SAPS II[b]					
Unscheduled surgery	1.6041	0.320	0.0000	4.973	2.65–9.31
LPA	0.9283	0.215	0.0000	2.530	1.65–3.86
Medical pathology	1.1727	0.233	0.0000	3.230	2.04–5.10
Age	0.0249	0.007	0.0006	1.025	1.01–1.04
Constant	– 3.3366	0.4621	0.0000		
Analysis with SAPS II[c]					
LPA	0.6916	0.240	0.0041	1.998	1.24–3.20
SAPS II	0.0966	0.010	0.0000	1.101	1.08–1.12
Age	0.0165	0.080	0.0387	1.016	1.00–1.03
Constant	– 5.7739	0.622	0.0000		

[a] Age and SAPS II were continuous variables, where odds ratio corresponds to one unit year and one unit point, respectively. Unscheduled surgery, medical pathology and LPA were dichotomous variables.

[b] Discrimination analysis: area under the receiver operating curve = 0.76 ± 0.03; calibration analysis: Ch = 18.06

[c] Discrimination analysis: area under the receiver operating curve = 0.83 ± 0.03; calibration analysis: Ch = 5.03

vious studies in critically ill patients (6,14,16) have not provided clear evidence of the relationship between PHS and mortality, even though common sense and medical experience suggest that there is a link. This lack of a clear relationship is confirmed in the present study. Earlier versions of severity scoring systems for use with critically ill patients, such as SAPS or the Acute Physiology and Chronic Health Evalution (APACHE), normally included PHS as a predictor of hospital outcome. However, in later validation studies of SAPS II (16), the two measures of PHS used (the A,B,C,D system and the MacCabe) were excluded from the final model. The classification of PHS used in APACHE II (13) was also excluded from APACHE III (14), as were co-morbidities in elective post-operative patients, as it was found that including co-morbidities did not improve global explanatory power in these patients. In the present study, apart from the low number in some admission categories, other factors which may have prevented us from obtaining more conclusive evidence of the expected relationship between PHS and mortality were the selection criteria used for ICU admission and a possible lack of sensitivity in the instruments used (KF and EQ-5D).

The fact that ICU selection criteria normally exclude terminally ill patients from admission to the ICU could also have affected the results obtained here. As PHS is taken into account by physicians when deciding which patients to admit to the ICU, patients with very poor a PHS would probably be excluded from the ICU and therefore from our sample. This would make it more difficult to demonstrate a clear relationship between a poor PHS and a higher mortality. Location prior to admission is a possible cause of selection bias (24). It could explain the results of the SAPS II calibration analysis obtained in our study. The existence of recovery units that initially attend and transfer critically ill patients to the ICU selectively may also create a bias that affects the association between PHS and outcome.

The reason for segregating scheduled surgery patients rather than other groups is based on different patient admission policies that may create different selection biases. The risks/benefits of surgery are evaluated first with the aim of selecting those patients who are expected to survive the process and to gain in life expectancy and/or quality of life. Given the discriminative capacity of medical tests used to select patients for surgery, it is not surprising that a relationship between PHS and mortality was not found in scheduled surgery patients using the generic health-related quality of life instruments included in this study.

When scheduled surgery patients were excluded from the overall sample, we found a statistically significant relationship between PHS and survival. There was also evidence of a trend towards a positive correlation between PHS and mortality in the remaining three admission categories when analysed individually, though it was not statistically significant. Given the rather low number in each category, however, the lack of statistical significance may simply be a question of the study being underpowered.

When we tested the ability of the EQ-5D to discriminate between survivors and non-survivors according to PHS, but controlled for age, we found that the trend towards a positive correlation between better PHS and lower mortality was maintained, but that statistical significance was lost. This indicates the importance of bearing in mind the likely confounding influence of age on VAS or other PHS scores when using this type of instrument. Nevertheless, the high initial correlation between PHS and mortality and the lack of a study design which explicitly tested the interaction between age and PHS scores suggests further investigation may be warranted, though in larger samples. The results obtained here also seem to indicate that scheduled surgery patients should be analysed separately, as their inclusion in the overall sample tended to obscure the tendency towards a positive correlation between higher PHS and increased survival in the other groups.

Finally, although the EQ-5D may appear to be a relatively simple instrument, there was very strong evidence to suggest that it could discriminate between survivors and non-survivors in the subgroups of trauma, unscheduled surgery and medical patients, although this effect was confounded with that of age. In order to determine the degree to which the EQ-5D might provide additional information regarding the likelihood of survival, a more specific study design would be needed to confirm or refute this possibility. This, coupled with the instrument's robustness, simplicity and reasonable agreement between patients and proxies would warrant further investigation of its use as a predictor of hospital outcome. If, however, it did prove to be insufficiently sensitive in predicting hospital outcomes, a further possibility would be to use disease-specific instruments for different disease categories, although comparability across groups would then be lost. Likewise, although agreement between proxy and patient responses was reasonable on EQ-5D dimensions and on the VAS, the use of information supplied by proxies necessarily imposes limitations on the interpretation of results. Nevertheless, at present it is the only way to gather information on PHS for patients attending the ICU, as discussed in an earlier study (17) on using the EQ-5D with proxies.

In conclusion, this study has shown, firstly, that the PHS of patients varies across admission categories, and, secondly, that the PHS of critically ill patients as measured by the EQ-5D and KF is not correlated to mortality. Nevertheless, further studies using the EQ-5D to investigate whether or not it can explain additional variance in mortality over and above age seem to be warranted, but such studies should include greater numbers of patients in each admission category, admission categories should be analysed separately, and patients should be classified not only by admission category but also in carefully defined age groups. Only then will it be possible to determine whether the EQ-5D can contribute significantly to the prediction of hospital outcome.

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