Predicting Patient Participation to an ICU Follow-Up Program

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Research

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Abstract

Objective: Survivors of intensive care often present long-term sequelae, including cognitive impairment and psychological discomfort. Follow-up programs have therefore been developed to assess and manage these long-term complications. Studying the effectiveness of such programs can be limited by the number of patients lost during follow-up. The aim of this study was therefore to evaluate patient characteristics predictive of participation to an intensive care unit (ICU) follow-up program.

Design: In this prospective, nested, case-control study, all patients with an ICU stay of at least five days were invited to participate in an ICU follow-up program. Having attended 2 follow-up sessions at ICU and hospital discharge, they were given an appointment for their 3-month follow up. Patients were divided into two groups ("participants and "non-participants") according to whether or not they attended this appointment. Multivariable logistic regression analysis was used to identify independent predictors of participation.

Settings: An ICU follow-up program from a mixed ICU at a university hospital.

Participants: All patients selected to participate to the ICU follow-up program were included in this study. They were allocated into two groups depending on their attendance in the follow-up program.

Intervention: None

Main results: Of the 199 patients included during the study period, 80 (40.2%) were classified as "participants". These patients had a lower Charlson Comorbidity Index, a longer ICU length of stay (LOS), more frequently received ventilatory support for at least 24 hours and more frequently received extracorporeal membrane oxygenation (ECMO) than non-participant patients. In the multivariable analysis, ICU LOS longer than 10 days was associated with a 3.3 times increased likelihood of participating in the follow-up; a lower Charlson Comorbidity Index also predicted an increased likelihood of participating to the ICU follow-up clinic.

Conclusions: Fewer comorbidities and longer intensive care LOS were independent predictors of participation in ICU follow-up.

Background

The increased numbers of ICU survivors in recent years carries with it concern regarding long-term outcomes of these patients given the considerable morbidity and mortality reported after ICU discharge. Mortality rates range from 16–21% during the first post-ICU year [1–3]. Long-term morbidity includes post-intensive care syndrome (PICS), which has psychological, physical, and cognitive components (1, 2). The quality of life of ICU survivors is worse compared to the general population (3–5), with up to 62% reporting cognitive impairment and up to 46% anxiety during the first year after discharge (6, 7).

The concept of ICU follow-up services led by intensive care professionals was first suggested a few decades ago, aiming to evaluate and manage the aforementioned sequelae of critical illness (8–12). ICU follow-up programs have been shown to provide psychological support for patients and families (13–16). Unfortunately, patient loss to follow-up can be substantial (11–38%), impacting the interpretation of results from studies of ICU follow up and influencing costs of these programs (17–20). Unlike other follow up or rehabilitation programs, such as cardiac rehabilitation, limited data have been published regarding adherence to ICU follow-up programs and possible reasons for patient loss to follow up (17–19), with the majority of randomized controlled trials not exploring these factors (21–24). Moreover, data that are available were of poor quality (25–27). In cardiac rehabilitation programs, likelihood of patient adherence was increased in patients with more comorbidities, higher socioeconomic status and better health insurance coverage(28).

To maximize the efficiency and effectiveness of ICU follow up, it is essential to identify patients with a higher probability of participation and to recognize adjustable factors associated with attendance to reduce loss to follow up. In this study, we explore possible patient-related factors predictive of participation to an ICU follow-up program.

Methods

This prospective nested case-control study was designed using the Strengthening the Reporting of Observational Studies Guidelines (STROBE checklist) (29). The study was conducted according to good clinical practice (Declaration of Helsinki 2002) after ethical committee approval (IRB 2018/443). Patients were included from December 2017 to December 2019.

Settings

In November 2017, the multidisciplinary ICU at Erasme hospital launched an ICU follow-up program in which patients were evaluated by a multidisciplinary team at four different moments: (1) ICU discharge; (2) hospital discharge; (3) 3- and (4) 6-months after ICU discharge.

Participants

All consecutive adult (≥ 18 y) patients admitted to the ICU who stayed for at least five days were eligible for the program; the procedure of the ICU follow-up program is described in the supplement. As the ICU follow-up program was implemented progressively, only patients discharged to cardiac surgery, thoracic surgery, and gastroenterology departments were included in the present study. Exclusion criteria for the program were language barrier (inability to communicate in French), transfer to another institution, neurological sequelae (e.g., coma), life expectancy of less than six months, drug dependency, and pregnancy with delivery date expected within 6 months of ICU discharge.

At 3-months post-ICU discharge, patients were allocated to one of two groups: (1) *participant group*, which comprised all patients who had attended their 3-month consultation; (2) *non-participant group*,

which comprised all patients who had refused to participate in the follow-up program or who had agreed but did not attend their 3-month consultation. All patients who were dead at three months after ICU discharge were excluded from the analysis.

Study objectives

The study's primary aim was to compare the socioeconomic, demographic and clinical profile of patients who participate in the ICU follow-up program versus those who did not. As a secondary aim, we evaluated factors that were predictive of ICU follow-up participation.

Data collection

We collected data at admission, during hospitalization, and after hospital discharge. The variables recorded were: (1) demographic data (age and sex); (2) clinical data [Charlson Comorbidity Index, Simplified Acute Physiology Score (SAPS III), Sequential Organ Failure Assessment (SOFA) at admission, reason for ICU admission, ICU LOS, hospital LOS; (3) organ support used during the ICU stay [mechanical ventilation (MV), renal replacement therapy (RRT), vasopressors, and MV free-days (number of ICU LOS without MV support)]; (4) socioeconomic status (average annual income and health insurance coverage); (5) employment status (employed, retired, not working because of physical or mental disability (related or not to ICU admission), unemployed), manual or non-manual employment; (6) accessibility (distance from patient home to hospital) and habitation status (living alone or with family).

Statistical analysis

The study was designed to enroll 160 patients (80 patients in each group) to provide statistical power of 80 % at a significance level of 0.05. The sample size was based on a mean difference of 1 point in the Charlson Comorbidity Index and a standard deviation of 2.25. In a previous study, the Charlson Comorbidity Index was the only variable independently associated with ICU follow-up participation (20). We performed statistical analysis with SPSS version 26.0 software (SPSS, Chicago, IL, USA). All results are expressed as medians (interquartile ranges) or counts (percentage) as appropriate. Normality distribution of variables was verified using the Shapiro-Wilk test. There were no missing data.

We analyzed variables with non-Gaussian distribution using non-parametric tests for independent samples (Mann-Whitney tests). Numerical variables with Gaussian distribution were compared using a T-test for independent samples. Categorical variables were analyzed using a Chi-square Pearson correlation test (30). We performed receiver operating characteristic (ROC) curve analysis for numerical data with a significant statistical difference to identify the best cutoff value for each variable. We then transformed the numerical data using the cutoff value into a categorical variable. A logistic regression analysis was used to ascertain the effects of variables, verify their independence, and identify the predictive value (31). A selection process was performed with only variables associated with the outcome with a significant statistical difference at the 0.1 level during univariable analysis considered in the multivariable analysis (32). Collinearity was excluded prior to modeling. A test of goodness of fit was performed using the Hosmer–Lemeshow test on the complete case model (33).

Results

The polyvalent ICU has around 2700 admissions per year, with a median patient length of stay (LOS) of 1 day (IQR 1–3). During the study period (December 2017 to December 2019), 4606 patients were admitted and 925 (20.1%) had an ICU LOS of at least 5 days. Of the 199 eligible patients for the ICU follow up program during this period, 161 were alive at 3-months after ICU discharge and were included in this study (cumulative 3-month mortality rate 19%) (Fig. 1). The ICU and hospital mortality rates for all eligible patients were 4.5% (n = 9) and 13.1% (n = 26), respectively. Eighty patients (49.7%) participated in the follow-up program (i.e., attended the 3-month consultation) and 81 (50.3%) did not.

The reasons for ICU admission were: medical 92 (57.1%), scheduled surgery 38 (23.6%), and emergency surgery 31 (19.3%). The reasons for admission were similar in those who participated in the ICU follow-up program and those who did not (p = 0.315). The Charlson Comorbidity Index was lower in participating than in non-participating patients [2 (0–3) vs 3 (1–5); (p = 0.004)] (Table 1). The prevalence of anxiety was slightly higher in participating than in non-participating patients [8 (10%) vs 3(3.7%) patients; (p = 0.113)], but this difference was not statistically significant.

Patients who participated in the ICU follow up program had longer ICU LOS than those who did not [12 (7–23) vs 8 (7–13) days; (p = 0.003)]. An ICU LOS of 10.5 days had a specificity of 74% and a sensitivity of 50% for prediction of participation in the follow up program (Fig. 2). Patients who stayed at least 11 days in the ICU were more likely to participate in the ICU follow-up than those with a shorter ICU LOS [40 (50%) vs 21 (25.9%); p = 0.002].

The use of mechanical ventilation (MV) for at least 24 h was also related to higher participation in ICU follow-up [56 (70%) versus 42 (52.9%); p = 0.018]. However, the duration of mechanical ventilation had no significant impact [participant 3 days (IQR 1–9) vs non-participant 2 days (IQR 1–6); p = 0.432]. A cutoff of nine MV-free days had a specificity of 81% and a sensitivity of 45% for prediction of participation in the follow up program. Patients who stayed on the ICU with more than nine MV-free days were more likely to participate in the ICU follow-up program [27 (48.2%) versus 10 (23.8%); p = 0.014].

No socioeconomic status variables (annual income and health insurance coverage) were associated with ICU follow-up participation. There was a small tendency for more manual workers in the participant group than in the non-participant group [24 (30%) vs 14 (17.3%); p = 0.057]. The distance from a patient's home to the hospital (p = 0.871) and the patient's habitation status (p = 0.428) were not significantly different in participant and non-participant groups.

In multivariable analysis, three factors were independently associated with ICU follow-up participation (Fig. 3). A lower Charlson Comorbidity Index was associated with an increase in the likelihood of participation. Patients with an ICU LOS of at least 11 days had a 77% likelihood of participating in the ICU follow-up program. However, patients who received RRT had a likelihood of only 17% of participating in the program. The logistic regression model was statistically significant, $x^2(5) = 31.953$; $p < 0.001$. The

model explained 24% (Nagelkerke R^2) of the variance in participation and correctly classified 65.2% of the cases. The Hosmer–Lemeshow test validated the fit of the model.

Discussion

The results of this study show several factors that can affect participation to ICU follow-up clinics, notably ICU length of stay, comorbidities, and use of mechanical ventilation and extracorporeal oxygenation membrane support during the ICU stay.

The Charlson Comorbidity Index was the only factor associated with adherence to ICU follow-up in a previous publication (20). In our study, we also found that this index influenced participation rate in the ICU follow-up program at 3-months with patients with lower indexes more likely to attend. A possible explanation for this finding may be that acute illness may have a less marked impact on a patient with chronic illness than on a previously healthy patient. Chronically ill patients may become more used to dealing with limitations to daily life, whereas an acute disease in a previously healthy patient may be more likely to create a source of discomfort and uncertainty. Moreover, patients with chronic conditions are often already followed by one or more specialists, thus already attending a number of other consultations, potentially justifying the lower participation in the ICU follow-up clinic. In this situation, the ICU follow-up could be perceived as less crucial. It would be interesting to assess whether changing the method of delivery of follow-up, using a telephone-based interview for example, would help increase participation for patients who present a higher number of comorbidities.

Patients who stayed in the ICU for more than ten days were twice as likely to participate in the follow-up program than patients with a shorter ICU LOS, and patients who stayed on the ICU with more than nine MV-free days were almost three times more likely to participate. The prolonged stay exposes the patient to the same people (ICU team), which may increase the possibility of building empathy. That personal attachment may explain why such patients would be more likely to come back to an ICU consultation. Qualitative studies can provide interesting results in this context and should be encouraged when evaluating patient and healthcare provider attitudes towards ICU follow-up programs.

We identified one congruent and two contrasting factors for prediction of program participation when compared to studies of burn unit follow-up and cardiac rehabilitation programs. A higher number of comorbidities was related to less patient attendance for all follow-up programs (34–36). However, unlike the results for cardiac rehabilitation and burn unit follow-up, socioeconomic status and health insurance coverage had no significant impact on the participation rate in our study. Moreover, the physical distance from the hospital did not impact patient participation. However, Belgium is a small country, which may play an important role in this context. As noted by Williams and Leslie, reduced access to health services in large countries, such as Australia, can impact ICU follow-up clinic attendance and effectiveness (26).

This is the first study in which patient participation in an ICU follow-up program has been assessed prospectively. Other strengths of this study are that the required sample size to achieve statistical power

was estimated and met and that extensive data on factors likely to influence participation (socioeconomic, clinical and accessibility factors) were collected. We did not assess the correlation between attendance at the follow-up and other consultations at the same hospital. The presence of multiple consultations on the same day or at the same hospital may interfere with a patient's decision to attend or not the ICU follow-up clinic. We used only a quantitative methodology for this study, so did not apply the Health Belief Model that might have helped understand patients' beliefs and reasons using a qualitative approach (37). Other limitations include that there was no external validation and not all ICU patients were eligible for the follow-up program. It would be interesting to design a multicenter cohort study to validate the findings.

Conclusion

Understanding the factors that influence patient participation in ICU follow-up programs may help identify those aspects that could be modified to reduce loss to follow-up studies. Improved knowledge in this field can also help health professionals to improve communication with patients at risk of not participating. Studies tailored at assessing these issues should be considered, for example, with protocols personalized to patients' needs or with shorter, less time consuming consultations. Our results can help those involved in developing and running ICU follow-up programs create new strategies to overcome barriers and increase patient participation.

List Of Abbreviations

ICU intensive care unit

IQR interquartile range

LOS length of stay

MV mechanical ventilation

PICS post-intensive care syndrome

ROC receiver operating characteristic

SAPS III Simplified acute physiology score 3

SOFA Sequential organ failure assessment score

STROBE Strengthening the reporting of observational studies in epidemiology

Declarations

Ethics approval

IRB 2018/443.

Consent to participate

Verbal consent

Consent for publication

Granted

Availability of data and material

On request

Conflict of interest

None

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None

Author's contributions

DP and JCP designed this study. CS and MD helped with patient's consent and data collection. DP was responsible for data collection, analysis and drafted the manuscript. JC and JCP supervised the writing and revised the manuscript. All authors gave final approval of the version to be published and agree to be accountable for all aspects of the work.

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Tables

Table 1: Patients’ characteristics per group

Results expressed as count (percentage) or median (interquartile range)

Data category	Variables	All patients (n=161)	Adherent group (n=80)	Non-Adherent group (n=81)	p-value
Demographic	Age (years)	63 (53-72)	60 (52-70)	61 (43-71)	0.153
	Male gender (n)	97 (60.2%)	47 (48.5%)	50 (51.5%)	0.699
Clinical	SAPS III	55 (45-71)	59 (46-73)	58 (45-80)	0.514
	SOFA at ICU admission	9 (6-12)	9 (6-12)	9 (6-12)	0.811
	Charlson Comorbidity Index	2 (1-4)	2 (0-3)	3 (1-5)	0.004
	Anxiety (yes, n)	11 (6.8%)	8 (10%)	3 (3.7%)	0.113
	Depression (yes, n)	41 (25.5%)	24 (30%)	17 (21%)	0.189
	Chronic pain (yes, n)	43 (26.7%)	25 (31.3%)	18 (22.2%)	0.195
	ICU LOS (days)	10 (7-19)	12 (7-23)	8 (7-13)	0.003
	Hospital LOS (days)	39 (23-66)	45 (24-67)	30 (20-56)	0.154
	Sepsis during ICU (yes, n)	50 (31.1%)	29 (36.3%)	21 (25.9%)	0.157
	Delirium during ICU (yes, n)	18 (11.2%)	10 (12.5%)	8 (9.9%)	0.597
Support used	ICU readmission* (yes, n)	33 (20.5%)	16 (20%)	17 (21%)	0.877
	Hospital readmission** (yes, n)	47 (29.2%)	22 (27.5%)	25 (30.9%)	0.639
	MV for at least 24h (yes)	98 (60.9%)	56 (70%)	42 (51.9%)	0.018
	Duration of MV (days)	2 (1-7)	3 (1-9)	2 (1-6)	0.432
	Vasopressor use (yes, n)	101 (62.7%)	55 (68.8%)	46 (56.8%)	0.117
	ECMO use (yes, n)	14 (8.7%)	12 (15%)	2 (2.5%)	0.005
	RRT use (yes, n)	24 (14.9%)	8 (10%)	16 (19.8%)	0.082
Socioeconomic	Distance (km)	19.5 (9-60)	17 (9-59)	27.5 (8-65)	0.871
	Annual income (euros)	15701 (13020-18013)	15701 (13020-19349)	15983 (12475-17324)	0.385
	BIM***(yes, n)	43 (26.7%)	19 (23.8%)	24 (29.6%)	0.399
		38 (23.6%)	24 (30%)	14 (17.3%)	0.260
		79 (49.1%)	36 (45%)	43 (53.1%)	
		38 (23.6%)	18 (22.5%)	20 (24.7%)	
		6 (3.7%)	2 (2.5%)	4 (4.9%)	

Employment status	
Employed	
Retired	
Handicap	
Unemployed	

SOFA Sequential Organ Failure Assessment; SAPS Simplified Acute Physiology Score; ICU intensive care unit; LOS length of stay; MV mechanical ventilation; ECMO extra circulatory membrane oxygenation; RRT renal replacement therapy. *ICU readmission at the same hospitalization **Hospital readmission over 6-months after ICU discharge ***BIM (bénéficiaire d'intervention majorée) is a Belgium social class with tax and health insurance benefits because of their deprived social condition.

Figures

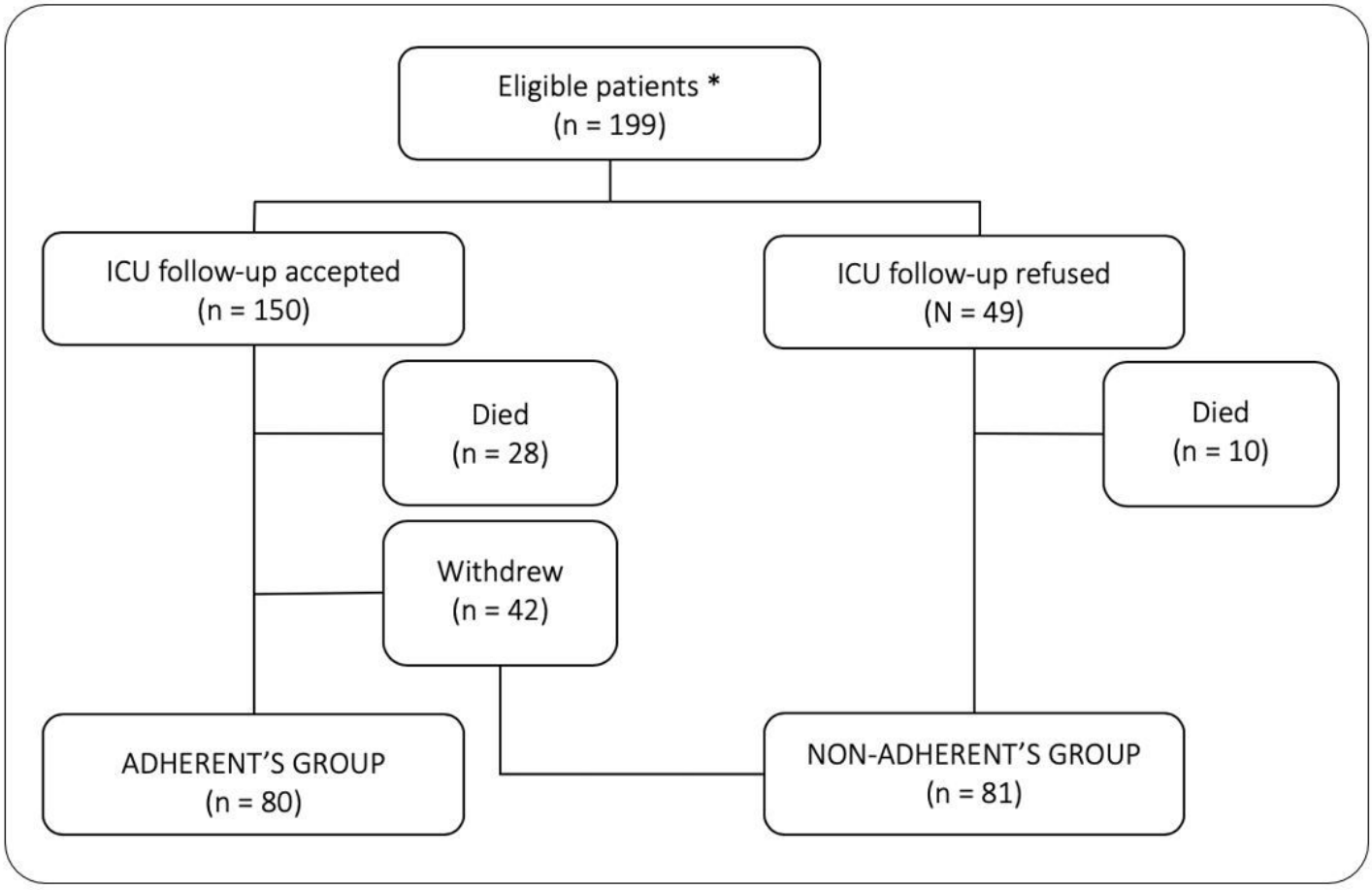

Figure 1

Study flow-chart a only cardiac surgery, thoracic surgery, and gastroenterology departments were included in the ICU follow-up program at this time. b social problems were defined as patients with drug dependency, in prison, with a high risk of non-treatment compliance, homeless, and current psychiatry hospitalization. c transfer to other hospitals so that it became impossible to follow-up the patient. d life < 6-months: all patients with a life-expectancy < 6 months

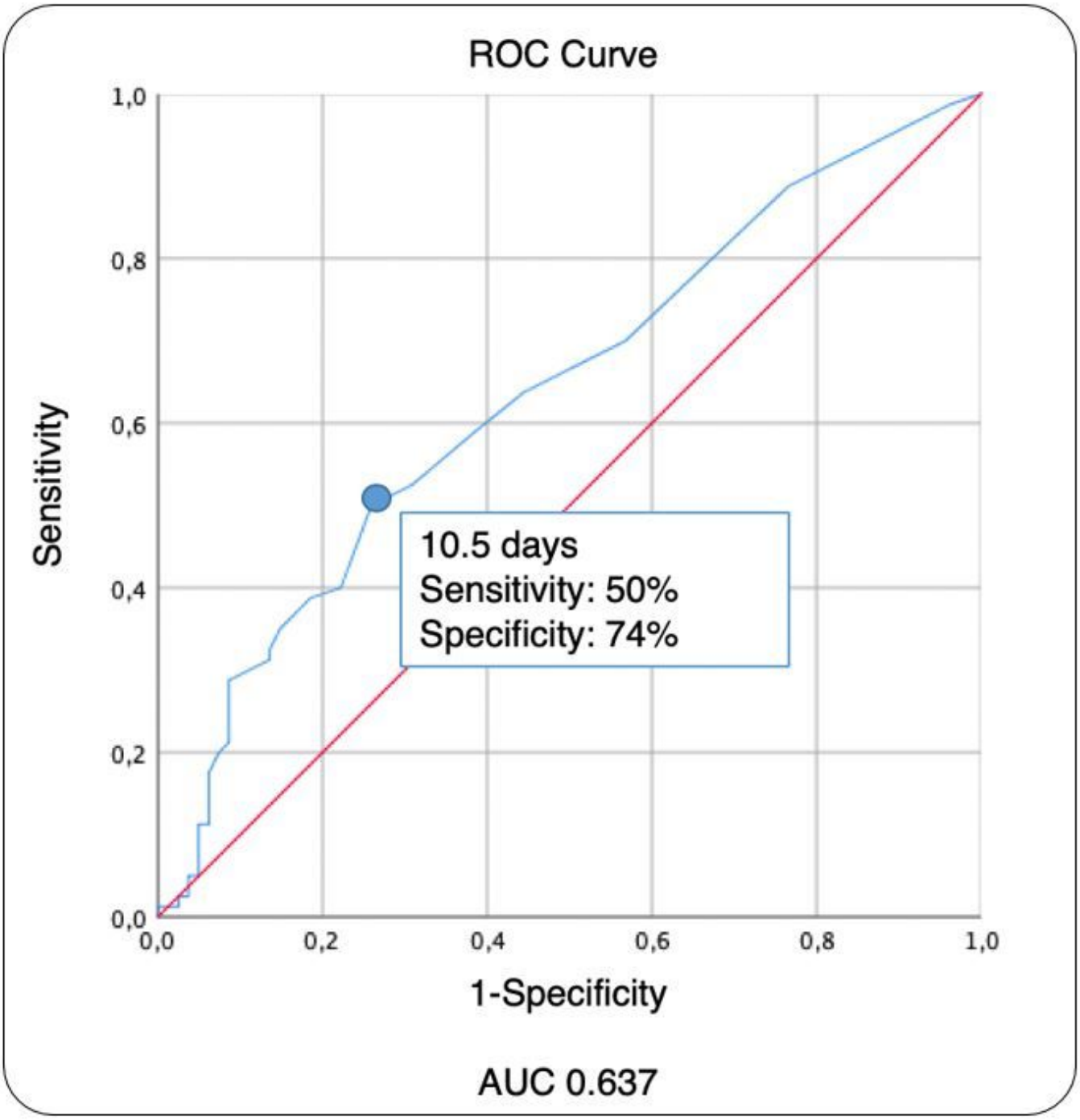

Figure 2

Area under the receiver operating characteristics curve (AUC) for ICU length of stay

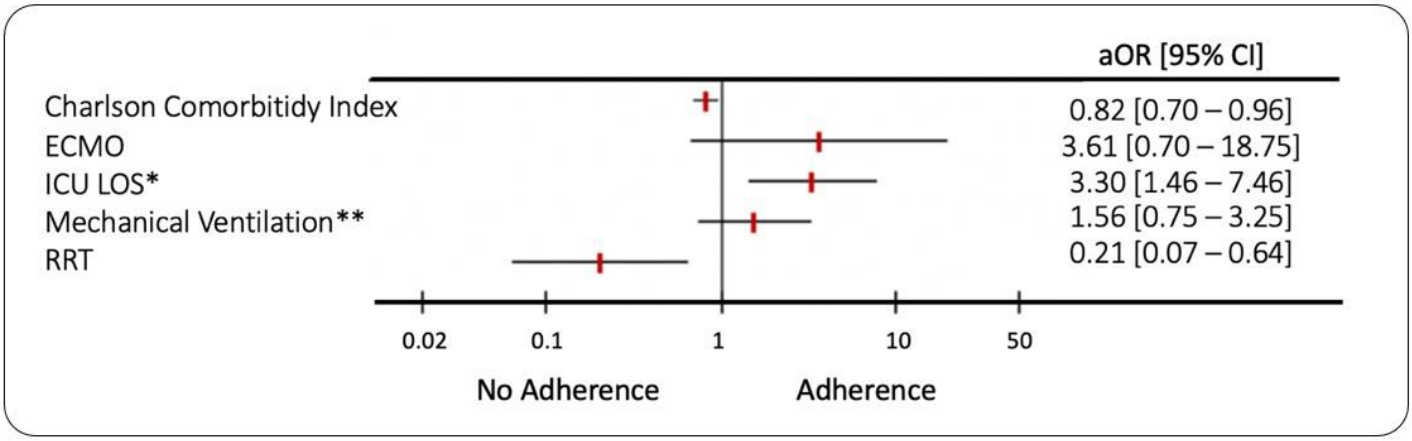

Figure 3

Clinical predictors of participation in ICU follow-up program ECMO extracorporeal membrane oxygenation; ICU Intensive Care Unit; LOS length of stay; RRT renal replacement therapy; aOR adjusted-odds ratio; CI confidence interval. *ICU length of stay > 10 days **Mechanical ventilation of at least 24h

Supplementary Files

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