Research Square

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A Multidimensional Assessment of Surrogate Decision Quality in Neurocritical Care for Patients with Stroke

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Abstract

Background

Surrogate decision-making is common in neurocritical care, particularly for patients with severe stroke who lack decisional capacity, yet decision quality remains difficult to define and measure. Existing studies often rely on single indicators, potentially obscuring important distinctions between the decision-making process, subsequent emotional appraisal, and alignment of care with patient goals.

Methods

We conducted a cross-sectional study of 315 family surrogate decision-makers for patients with severe stroke admitted to neurocritical care units in a tertiary hospital in China. Decision quality was assessed using three indicators: decision satisfaction (decision-making subscale of the Family Satisfaction in the Intensive Care Unit survey), decision regret (the Decision Regret Scale), and perceived goal-concordant care. Associations with patient, surrogate, and clinical characteristics were examined using univariate and multivariable analyses, and relationships among the three indicators were evaluated.

Results

Decision satisfaction was generally high; lower satisfaction was associated with haemorrhagic stroke, mechanical ventilation, and higher household income. More than 60% of surrogates reported some decision regret, with higher regret associated with haemorrhagic stroke, nasoenteric tube feeding, and transition from aggressive to restrictive treatment. Most surrogates perceived care as goal-concordant (78.4%), while 16.8% were uncertain; previous ICU caregiving experience remained associated with perceived goal-concordant care in multivariable analysis. Decision satisfaction and regret were moderately inversely correlated, whereas perceived goal-concordant care showed a weak correlation with decision satisfaction and no significant correlation with regret.

Conclusions

Decision satisfaction, decision regret, and perceived goal-concordant care capture complementary but non-redundant dimensions of surrogate decision quality for patients with severe stroke receiving neurocritical care. Their distinct patterns of association suggest that reliance on any single indicator may provide an incomplete understanding of surrogate decision quality. Multidimensional assessment may help identify different informational, emotional, and decisional support needs among family surrogates.

Introduction

Decision-making in neurocritical care for stroke patients frequently occurs under conditions of profound uncertainty, time pressure, and high emotional stakes [1–4]. Patients with severe stroke often lack decisional capacity, requiring family members to act as surrogate decision-makers for potentially life-altering treatments, including surgical intervention, mechanical ventilation, and decisions regarding life-sustaining therapy [5–7]. In this study, surrogate decision-maker refers to a family member who makes medical decisions on behalf of a patient who lacks decisional capacity, consistent with usage in decision science and bioethics literature. Such decisions are clinically consequential and psychologically demanding, with lasting implications for how decision-makers evaluate both the decision-making experience and its outcomes [6, 8, 9].

Within decision science, decision quality is increasingly conceptualised as a multidimensional construct encompassing alignment with patient values and the decision-maker's psychological appraisal of the decision-making process and outcomes [10–13]. This perspective recognises that decision quality cannot be inferred solely from clinical outcomes, particularly in contexts characterised by uncertainty and limited control over results. Instead, high-quality decisions are informed, deliberative, and value-sensitive when made, even when subsequent outcomes are unfavourable. In critical care, surrogate decision-makers' evaluations therefore provide important insight into how complex decisions are navigated under prognostic uncertainty and emotional burden [8, 14, 15].

Surrogate decision-making in neurocritical stroke care represents a particularly challenging form of high-stakes decision-making under uncertainty [2, 16, 17]. Unlike patients making preference-sensitive decisions about their own care, surrogates make decisions for another person, often without explicit knowledge of that person's preferences and under substantial time pressure and emotional distress [2, 15]. These conditions challenge traditional decision models that assume stable preferences, adequate deliberation time, and well-defined outcome probabilities [18, 19]. Consequently, different dimensions of decision quality, including process experience, emotional outcomes, and value alignment, may diverge in meaningful ways.

Decision satisfaction reflects surrogates' appraisal of the decision-making process, including perceived communication quality, emotional support, and involvement during deliberation, and is widely used as a proximal indicator of perceived process quality [5, 20, 21]. Decision regret represents a downstream emotional outcome, capturing negative psychological evaluation of decisions through counterfactual thinking as outcomes unfold [8, 22–24]. Goal-concordant care provides a complementary normative indicator, reflecting the extent to which delivered care is perceived to align with the patient's values and preferences [25–27]. Together, these indicators capture distinct but interrelated dimensions of surrogate decision quality. Despite their conceptual relevance, these constructs are rarely examined jointly in high-stakes surrogate decision-making contexts.

To address this gap, we developed a conceptual framework informed by decision science theory and prior empirical research (Fig. 1) [23, 28]. The framework proposes that decisional antecedents—including patient clinical characteristics, treatment intensity, and family experience—shape the perceived decision-

making process, operationalised as decision satisfaction, and influence subsequent decision outcomes, including decision regret and perceived goal-concordant care, through both direct and indirect pathways. Although this study did not directly observe decision-making interactions or communication behaviours, it assesses family members' retrospective appraisals of the decision-making experience using validated measures. Such appraisals represent a central component of decision quality in decision science, particularly in contexts where real-time observation of decision processes is impractical.

Guided by this framework, we conducted a cross-sectional survey of family surrogate decision-makers of patients with severe stroke admitted to intensive care units (ICUs). The study aimed to: (1) describe family members' levels of decision satisfaction, decision regret, and perceived goal-concordant care; (2) examine associations between decisional antecedents and these indicators; and (3) evaluate the relationships among the three indicators.

The framework illustrates how decisional antecedents (patient characteristics, clinical severity, treatment intensity, and family experience) shape surrogate decision-makers' perceived decision-making process (decision satisfaction) and influence downstream decision outcomes, including decision regret and perceived goal-concordant care. Arrows indicate hypothesised direct and indirect relationships among constructs.

Methods

Study Design

This study employed a cross-sectional survey design and is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [29].

Setting and Sampling

The study was conducted at a tertiary medical centre in central China with dedicated neurological intensive care services. Convenience sampling was used to recruit family surrogate decision-makers of patients with severe stroke admitted to either a general ICU or a neurological ICU, reflecting the pragmatic constraints of recruitment in acute neurocritical care settings.

Eligible patients were aged ≥ 18 years, had a confirmed diagnosis of ischemic or haemorrhagic stroke, an ICU stay exceeding 48 hours, and severe neurological impairment, defined as a Glasgow Coma Scale (GCS) score ≤ 12 on admission. Patients were excluded if they lacked an identifiable surrogate decision-maker, were admitted following planned neurosurgical procedures, or were admitted for traumatic brain injury, oncological stroke, or hypoxic–ischemic encephalopathy. Eligible family participants were aged ≥ 18 years and identified as the primary surrogate decision-maker during the neurocritical care period.

Sample Size

Sample size was estimated using Raosoft (http://www.raosoft.com/samplesize.html). Based on estimates of stroke burden in China in 2020, the population size was set at 178,000 [30]. With a 5% margin of error, 95% confidence level, and an expected response distribution of 80% based on previous studies [31, 32], the required sample size was 246. Allowing for an anticipated 20% rate of incomplete or invalid responses, the target sample size was 308 participants.

Measures

Decision Antecedent Variables

Data on patient demographics, clinical characteristics, and treatment factors were collected, including age, sex, stroke type, prior stroke history, GCS score on admission, activities of daily living (ADL) at discharge, ICU length of stay, treatment modalities during neurocritical care, and in-hospital treatment status.

Treatment status was classified into three categories based on documented treatment decisions during the ICU admission: aggressive treatment, restrictive treatment, and transition from aggressive to restrictive treatment. Aggressive treatment referred to the continued use of all clinically indicated life-sustaining and organ-supportive treatments. Restrictive treatment referred to a documented decision to withhold or withdraw one or more life-sustaining treatments and not to escalate treatment further. A transition from aggressive to restrictive treatment was recorded when a patient initially received aggressive treatment but subsequently had a documented decision during the same ICU admission to limit, withhold, or withdraw life-sustaining treatment. Classification was based on treatment decisions documented in the hospital information system.

Family-level variables included age, sex, education, relationship to the patient, and prior ICU care experience. These antecedent variables were selected based on prior literature identifying factors potentially associated with decision quality [14, 21–23] and their availability from participant reports or routine clinical records.

Decision Satisfaction

Decision satisfaction was assessed using the decision-making subscale of the Family Satisfaction in the Intensive Care Unit survey (FSICU-DM) [20]. This 10-item instrument assesses perceived adequacy of information, emotional support, and involvement in the decision-making process. Items are rated on a 5-point Likert scale and transformed to a 0–100 scale, with higher scores indicating greater satisfaction. The FSICU-DM has demonstrated good reliability and validity in critical care populations, including neurocritical care settings [31–33]. A validated Chinese version of the instrument was used.

Decision Regret

Decision regret was measured using the 5-item Decision Regret Scale (DRS) [24]. Items are rated on a 5-point Likert scale and converted to a 0–100 score, with higher scores indicating greater regret. The DRS has been used among surrogate decision-makers in critical care and validated in Chinese populations [32, 34, 35]. Given that patients in neurocritical care often face multiple high-stakes decisions and the DRS assesses regret related to a specific decision, participants were first asked to identify the most challenging decision they encountered from a predefined list prior to completing the DRS. This list was developed in consultation with on-site neurocritical care clinicians and included decisions commonly requiring surrogate deliberation in this context.

Goal-concordant Care

Perceived goal-concordant care was assessed by surrogate report, given the limited use of advance directives in China and the frequent lack of decisional capacity among patients with severe stroke. Surrogates were asked whether goals of care had previously been discussed with the patient and, if not, to indicate their perception of the patient's goals. Goal-concordant care was assessed using the question: "Do you believe the care your loved one received during this neurocritical care hospitalisation aligned with their personal goals?" Response options were "Yes," "No," or "Unsure." Consistent with prior research, goals of care were broadly categorized as life-prolonging versus comfort-focused [36].

Data Collection

Data were collected through the widely used online survey platform "QuestionStar" in China between January and September 2025. Family participants completed the survey when the patient was nearing hospital discharge; for patients with prolonged hospitalisation, the survey was administered after 30 days of admission. For patients who died in hospital or were discharged following treatment withdrawal, family members were contacted within one month. This timing was selected to balance sensitivity to bereavement with minimisation of recall bias. Clinical data were extracted from the hospital information system by trained research staff.

Data Analysis

Data were analysed using SPSS version 25.0. Univariate analyses examined associations between decisional antecedent variables and each decision quality indicator: decision satisfaction, decision regret, and perceived goal-concordant care.

FSICU-DM scores were analysed using independent samples *t*-tests and one-way analysis of variance (ANOVA) following assessment of normality. DRS scores were non-normally distributed and were analysed using nonparametric methods. Goal-concordant care, a three-category outcome, was analysed using multinomial logistic regression.

Variables with $P < 0.05$ in univariate analyses were entered into multivariable models to identify independent associations. Multiple linear regression was used for FSICU-DM, generalised linear models for DRS, and multinomial logistic regression for goal-concordant care. Spearman correlation coefficients were calculated to examine associations among FSICU-DM, DRS, and perceived goal-concordant care.

Ethical Considerations

Ethical approval

was obtained from the research ethics committees of the participating hospital and the affiliated university (KYLL-202312-223 and LS-24-72-Zhang-ODon). Electronic informed consent was obtained from all participants before survey completion, and all study data were de-identified to maintain confidentiality.

Results

Enrolment and Sample Characteristics

Participants were recruited from three general ICUs and two neuro-ICUs. Of 382 eligible surrogate decision-makers approached, 321 consented to participate (84.0%). After excluding six incomplete questionnaires, the final analytic sample comprised 315 participants.

Patient and surrogate characteristics are summarised in Table 1. Most patients were aged>60 years, were male, and had relatively low educational attainment. Haemorrhagic and ischemic strokes were similarly represented. Nearly three-quarters of patients received aggressive treatment during neurocritical care, and slightly more than one-fifth experienced a transition from aggressive to restrictive treatment. Surrogate decision-makers were predominantly middle-aged adults, most commonly the patients' adult children. Educational background and occupation varied, and approximately one-fifth (n=60, 19.1%) reported prior experience caring for a family member in an ICU setting.

Decision Satisfaction

The mean FSICU-DM score was 86.15 (SD 13.80). Item scores within the Information Needs dimension were consistently high (mean item score 8.63) with limited variability (SD range 1.65–1.82). The Process of Making Decisions dimension had a similar mean (8.60) but showed greater variability across items (maximum SD 2.48). At the item level, feeling included in decision-making received the highest ratings, whereas having sufficient time to express concerns and receive answers received the lowest ratings (Supplementary Table S1).

In univariate analyses (Table 2), FSICU-DM scores were significantly associated with patient age, stroke type, mechanical ventilation, nasoenteric tube feeding, and annual household income. In multivariable linear regression (Table 3), stroke type, mechanical ventilation status, and annual household income

remained significantly associated with decision satisfaction. No evidence of multicollinearity was observed.

Family members of patients with haemorrhagic stroke and those receiving mechanical ventilation reported lower FSICU-DM scores. Higher household income was associated with lower decision satisfaction, with an estimated decrease of 2.31 FSICU-DM points for each increase in income category. Families with annual incomes below ¥20,000 reported the highest mean satisfaction score (93.33, SD 8.74), compared with mean scores of 86.54 and 85.20 among those with annual household incomes of ¥100,000–200,000 and >¥200,000, respectively.

Table 1 Patient and family surrogate decision-maker characteristics (N=315)

Variables	Groups	Cases	Composition Ratio (%)
Patients' demographic characteristics and clinical information			
Age	18-30	8	2.5
	31-40	15	4.8
	41-50	26	8.3
	51-60	61	19.4
	>60	205	65.1
Gender	Male	193	61.3
	Female	122	38.7
Education	Primary school	176	55.9
	Secondary school	86	27.3
	High school or vocational school	26	8.3
	College degree or higher	27	8.6
Occupation	Farming	131	41.6
	Migrant worker	31	9.8
	Government or public institution employee	15	4.8
	Retired	51	16.2
	Freelancer	41	13
	Unemployed	46	14.6
Medical insurance	Employee insurance	75	23.8
	Urban/Resident medical insurance	227	72.1
	Commercial insurance or others	13	4.1
Stroke type	Haemorrhagic stroke	171	54.3
	Ischemic stroke	144	45.7
Previous stroke	No	210	66.7
	Yes	105	33.3
Survey	No	144	45.7
	Yes	171	54.3
Mechanical ventilation	No	96	30.5
	Yes	219	69.5
Tracheostomy	No	245	77.8
	Yes	70	22.2
Nasoenteric tube feeding	No	282	89.5
	Yes	33	10.5
GCS at admission	3-8	144	45.7
	9-12	171	54.3
ADL at discharge	80-100	20	6.3
	40-79	42	13.3
	0-39	253	80.3
ICU stay	≤7	172	54.6
	8-14	56	17.8
	>14	87	27.6
Treatment status	Aggressive treatment	235	74.6
	Restrictive treatment	12	3.8

	Treatment transition*	68	21.6
Families' demographic characteristics			
Age	18-30	13	4.1
	31-40	78	24.8
	41-50	111	35.2
	51-60	73	23.2
	>60	40	12.7
Gender	Male	189	60
	Female	126	40
Education	Primary school	57	18.1
	Secondary school	114	36.2
	High school or vocational school	71	22.5
	College degree or higher	73	23.2
Occupation	Farming	83	26.3
	Migrant worker	63	20.0
	Government or public institution employee	41	13.0
	Retired	26	8.3
	Freelancer	89	28.3
	Unemployed	13	4.1
Annual household income (RMB)	<20,000	43	13.7
	20,000-50,000	75	23.8
	50,000-100,000	129	41.0
	100,000-200,000	63	20.0
	>200,000	5	1.6
Relationship to the patient	Spouse	66	21
	Parent	28	8.9
	Child	206	65.4
	Sibling	4	1.3
	Friend	4	1.3
	Other	7	2.2
Previous ICU care experience	Yes	60	19.1
	No	255	80.9

Abbreviations: GCS, Glasgow Coma Scale; ADL, activities of daily living; ICU, intensive care unit; *Indicates a shift from aggressive treatment to restrictive treatment.

Table 2 Univariate associations between clinical and demographic factors and decision quality indicators (N=315)

Variables	Groups	FSICU-DM				DRS			Goal-concordant care	
		±s	*t/F*	*p*	LSD	Median（Q1,Q3）	*Z/H*	*p*	Yes	No
Patients' demographic characteristics and clinical information										
Age	18-30岁	85.62±9.03	F=2.501	0.043		0.00(0.00,22.50)	H=8.732	0.068	8(100)	0(0.0)
	31-40岁	93.16±9.88			丁>甲	10.00(0.00,35.00)			13(86.7)	0(0.0)
	41-50岁	79.61±16.21				27.50(10.00,41.25)			19(73.1)	1(3.8)
	51-60岁	86.27±13.46			乙>甲	15.00(0.00,30.00)			44(72.1)	5(8.2)
	>60岁	86.45±13.75			乙>甲	15.00(0.00,35.00)			163(79.5)	9(4.4)
Gender	Male	86.74±13.42	t=0.950	0.343		15.00(0.00,35.00)	Z=-0.239	0.811	148(76.7)	12(6.2)
	Female	85.22±14.40				10.00(0.00,35.00)	H=1.172	0.760	99(81.1)	3(2.5)
Education	Primary school	86.31±13.83	F=2.034	0.109		15.00(0.00,35.00)			137(77.8)	8(4.5)
	Secondary school	87.73±13.81				15.00(0.00,35.00)			73(84.9)	32(3.5)
	High school or vocational school	85.96±11.81				17.50(0.00,41.25)			21(80.8)	1(3.8)
	College degree or higher	80.27±14.54				20.00(0.00,40.00)			16(59.3)	3(11.1)
Occupation	Farming	86.35±13.93	F=1.595	0.161		15.00(0.00,30.00)	H=6.325	0.276	99(75.6)	10(7.6)
	Migrant worker	84.83±15.31				20.00(0.00,40.00)			23(74.2)	1(3.2)
	Government or public institution employee	79.00±17.08				15.00(10.00,50.00)			11(73.3)	2(13.3)
	Retired	89.38±12.92				5.00(0.00,25.00)			42(82.4)	2(3.9)
	Freelancer	84.39±11.50				25.00(0.00,35.00)			37(90.2)	0(0.0)
	Unemployed	86.15±13.80				17.50(0.00,35.00)			35(76.1)	0(0.0)
Medical insurance	Employee insurance	84.93±14.57	F=0.469	0.626		15.00(0.00,30.00)	H=0.376	0.828	59(78.7)	5(6.7)
	Urban/Resident medical insurance	86.44±13.69				15.00(0.00,35.00)			177(78.0)	10(4.4)
	Commercial insurance or others	88.07±11.55				10.00(0.00,30.00)			11(84.6)	0(0.0)
Stroke type	Haemorrhagic stroke	83.95±13.85	t=-3.135	0.002		20.00(0.00,35.00)	Z=-2.857	0.004	137(80.1)	7(4.1)
	Ischemic stroke	88.78±13.33				5.00(0.00,30.00)			110(76.4)	8(5.6)
Previous stroke	No	88.95±13.09	t=-1.551	0.122		20.00(0.00,40.00)	Z=-1.352	0.176	166(79.0)	10(4.8)
	Yes	84.45±14.14				15.00(0.00,30.00)			81(77.1)	5(4.8)
Surgery	No	86.91±13.07	t=0.089	0.374		15.00(0.00,40.00)	Z=-1.214	0.225	119(82.6)	2(1.4)
	Yes	85.52±14.41				15.00(0.00,30.00)			128(74.9)	13(7.6)
Mechanical ventilation	No	91.17±10.48	t=-2.404	0.017		20.00(0.00,35.00)	Z=-2.097	0.036	83(86.5)	1(1.0)
	Yes	84.92±13.95				5.00(0.00,30.00)			164(74.9)	14(6.4)
Tracheostomy	No	89.46±10.94	t=-1.607	0.109		20.00(0.00,40.00)	Z=-1.941	0.052	52(74.3)	6(8.6)
	Yes	87.06±11.29				10.00(0.00,30.00)			195(79.6)	9(3.7)
Nasoenteric tube feeding	No	81.52±16.99	t=2.051	0.041		15.00(0.00,35.00)	Z=-2.544	0.011	219(77.7)	15(5.3)
	Yes	86.70±13.32				10.00(0.00,30.00)			28(84.8)	0(0.00)

Variables	Groups	FSICU-DM				DRS			Goal-concordant care	
		±s	*t/F*	*p*	LSD	Median（Q1,Q3）	*Z/H*	*p*	Yes	No
GCS at admission	3-8	84.80±14.21	t=-1.591	0.113		17.50(0.00,40.00)	Z=-1.566	0.117	108(75.0)	9(6.3)
	9-12	87.28±13.39				10.00(0.00,30.00)			139(81.3)	6(3.5)
ADL at discharge	80-100	80.38±13.56	F=3.002	0.051		10.00(0.00,42.50)	H=5.576	0.062	18(7.3)	0(0.0)
	40-79	89.46±13.73				00.00(0.00,25.00)			36(14.6)	1(6.7)
	0-39	86.06±13.73				20.00(0.00,35.00)			193(78.1)	14(93.3)
ICU stay	≤7	87.73±13.76	F=2.666	0.071		10.00(0.00,35.00)	H=3.632	0.163	135(78.5)	7(4.1)
	8-14	83.48±13.80				22.50(0.00,37.50)			46(82.1)	4(7.1)
	>14	84.74±13.63				20.00(0.00,35.00)			66(75.9)	4(4.6)
Treatment status	Aggressive treatment	89.12±11.00	F=1.789	0.169		10.00(0.00,30.00)	H=12.461	0.002	191(81.3)	8(3.4)
	Restrictive treatment	93.67±8.73				10.00(0.00,27.50)			8(66.7)	0(0.0)
	Treatment transition*	87.41±11.42				25.00(5.00,45.00)			48(70.6)	7(10.3)
Family demographic characteristics										
Age	18-30	91.54±7.58	F=2.379	0.052		5.00(0.00,25.00)	H=7.122	0.130	12(92.3)	0(0.0)
	31-40	91.03±9.50				5.00(0.00,25.00)			52(66.7)	8(10.3)
	41-50	86.95±11.78				25.00(0.00,40.00)			89(80.2)	53(4.5)
	51-60	87.97±12.15				20.00(0.00,35.00)			60(82.2)	1(1.4)
	>60	91.20±9.67				7.50(0.00,35.00)			34(85.0)	1(2.5)
Gender	Male	88.02±11.19	t=-1.793	0.074		20.00(0.00,35.00)	Z=-0.823	0.410	145(76.7)	7(3.7)
	Female	90.29±10.73				12.50(0.00,30.00)			102(81.0)	8(6.3)
Education	Primary school	88.53±11.28	F=13.785	0.953		20.00(0.00,40.00)	H=4.642	0.200	44(77.2)	4(7.0)
	Secondary school	89.39±10.63				12.50(0.00,35.00)			99(86.8)	4(3.5)
	High school or vocational school	88.76±11.52				10.00(0.00,25.00)			52(73.2)	5(7.0)
	College degree or higher	88.66±11.23				15.00(0.00,35.00)			52(71.2)	2(2.7)
Occupation	Farming	88.46±11.29	F=1.438	0.210		20.00(0.00,40.00)	H=6.498	0.261	68(81.9)	4(4.8)
	Migrant worker	87.33±11.29				20.00(0.00,35.00)			48(76.2)	2(3.2)
	Government or public institution employee	89.02±12.71				15.00(0.00,30.00)			30(73.2)	2(4.9)
	Retired	94.08±7.83				00.00(0.00,25.00)			24(92.3)	0(0.0)
	Freelancer	88.87±10.66				15.00(0.00,35.00)			68(76.4)	7(7.9)
	Unemployed	89.38±9.50				15.00(0.00,30.00)			9(69.2)	0(0.0)
Annual household income (RMB)	<20,000	93.33±8.74	F=2.982	0.019	>>>	20.00(0.00,40.00)	H=0.277	0.991	34(79.1)	2(4.7)
	20,000-50,000	89.97±10.12				15.00(0.00,37.50)			59(78.7)	3(4.0)
	50,000-100,000	88.16±11.63				20.00(0.00,30.00)			101(78.3)	7(5.4)
	100,000-200,000	86.54±10.95				15.00(0.00,35.00)			49(77.8)	2(3.2)
	>200,000	85.20±18.36				15.00(0.00,35.00)			4(80.0)	1(20.0)

Variables	Groups	FSICU-DM				DRS			Goal-concordant care	
		±s	*t/F*	*p*	LSD	Median（Q1,Q3）	*Z/H*	*p*	Yes	No
Relationship to the patient	Spouse	88.91±10.73	F=1.534	0.179		22.50(0.00,40.00)	H=4.708	0.453	54(81.8)	2(3.0)
	Parent	93.50±8.07				5.00(0.00,40.00)			23(82.1)	2(7.1)
	Child	88.38±11.21				15.00(0.00,30.00)			156(75.7)	11(5.3)
	Sibling	82.20±15.58				20.00(7.50,25.00)			4(100)	0(0.0)
	Friend	93.50±7.55				25.00(7.50,35.00)			4(100)	0(0.0)
	Other	88.00±15.58				15.00(2.50,17.50)			6(85.7)	0(0.0)
Previous ICU care experience	No	89.22±11.25	t=-0.980	0.328		15.00(0.00,35.00)	Z=0.005	0.943	205(80.4)	14(5.5)
	Yes	87.67±10.57				15.00(0.00,32.50)			42(70.0)	1(1.7)
Goal-of-care discussion	No	84.78±14.36	t=-1.912	0.057		12.50(0.00,35.00)	Z=0.546	0.460	127(74.7)	9(5.3)
	Yes	87.76±12.99				15.00(0.00,35.00)			120(82.8)	6(4.1)

Abbreviations: GCS, Glasgow Coma Scale; ADL, activities of daily living; ICU, intensive care unit; LSD, least significant difference.

t: independent samples t-test; F: one-way ANOVA; Z: Mann-Whitney U test; H: Kruskal-Wallis H test. *Indicates a shift from aggressive treatment to restrictive treatment.

Table 3 Multivariable linear regression of factors associated with FSICU-DM

Variables	Unstandardized Coefficient		Standardized Coefficient	*t*	*p*
	B	*SE*	*Beta*		
(Constant)	94.966	5.255		18.072	<.001
Patient age	-0.692	0.781	-0.050	-0.886	0.376
Stroke type	4.388	1.576	0.159	2.785	0.006
Mechanical ventilation	-3.273	1.655	-0.109	-0.977	0.049
Nasojejunal tube feeding	-3.139	2.500	-0.070	-1.256	0.210
Annual household income	-2.310	0.769	-0.165	-3.004	0.003

Abbreviations: FSICU-DM, decision-making subscale of the Family Satisfaction in the Intensive Care Unit survey; SE, standard error.

Decision Regret

Before completing the DRS, participants identified the most challenging decision encountered during neurocritical care (Table 4). Surgical intervention and endotracheal intubation or mechanical ventilation were the most frequently identified decisions.

The mean DRS score was 18.51 (SD 18.74). More than one-third of participants (n=116, 36.8%) reported no decision regret, whereas nearly one-third (n=96, 30.5%) reported moderate to severe regret (DRS ≥ 30). The distribution of DRS scores is presented in Fig.2, with item-level results provided in Supplementary Table S2.

In univariate analyses (Table 2), DRS scores were significantly associated with stroke type, mechanical ventilation, nasoenteric tube feeding, and treatment status. In the generalised linear model (Table 5), haemorrhagic stroke, nasoenteric tube feeding, and transition from aggressive to restrictive treatment remained significantly associated with higher regret scores, whereas mechanical ventilation was no longer statistically significant.

Table 4 Medical decisions identified as most challenging by surrogate decision-makers (N=315)

Decision Options	Count	Proportion
• Surgical treatment (including hematoma removal, debridement decompression, interventional embolization, etc.)	139	44.1%
• Tracheal intubation and mechanical ventilation	131	41.6%
• Tracheotomy	67	21.3%
• Artificial nutrition (infusion of nutritional fluids via gastric or nasoenteric tube)	52	16.5%
• Resuscitation treatment (application of vasoactive drugs and cardiopulmonary resuscitation)	42	13.3%
• Withdraw of further treatment	59	18.7%
• Unsure	16	5.1%

Table 5 Generalised linear model of factors associated with DRS

Variable (Reference Group)	*B*	*SE*	Wald c^2	*p*
Intercept	32.707	4.240	59.502	<0.001
Stroke type (Ref: ischemic stroke)				
Haemorrhagic stroke	4.586	2.045	5.025	0.025
Mechanical ventilation (Ref: Yes)				
No	-2.833	2.243	1.594	0.207
Nasoenteric Tube Feeding (Ref: Yes)				
No	-9.246	3.402	7.384	0.007
Treatment status (Ref: treatment transition*)				
Restrictive treatment	-8.573	5.633	2.316	0.128
Aggressive treatment	-9.715	2.496	15.147	<0.001

Abbreviations: DRS, decision regret scale; SE, standard error. *Indicates a shift from aggressive treatment to restrictive treatment.

Goal-concordant Care

Among the 315 participants, 46.0% (n=145) reported having previously discussed goals of care with the patient, while 54.0% (n=170) had not. Among those reporting prior discussions, 51.7% (n=75) indicated that the patient preferred life-prolonging care, 22.8% (n=33) comfort-focused care, and 25.5% (n=37) were uncertain. Similar distributions were observed among participants without prior discussions, based on surrogates' perceptions of patient preferences.

Overall, 78.4% (n=247) of surrogate decision-makers perceived that the care received was concordant with the patient's goals, 4.8% (n=15) perceived it as non-concordant, and 16.8% (n=53) were uncertain (Supplementary Table S3). In univariate analyses, perceived goal-concordant care was significantly associated with mechanical ventilation, surgery and previous ICU care experience (Table 2).

These three variables were subsequently entered into a multinomial logistic regression model, with "Unsure" as the reference category (Table 6). In the comparison between "Yes" and "Unsure", surrogates without previous ICU care experience had higher odds of reporting goal-concordant care than those with previous ICU care experience (OR 2.316, 95% CI 1.187–4.519; p=0.014). Mechanical ventilation and surgery were not significantly associated with this comparison after adjustment. No statistically significant associations were identified for the comparison between "No" and "Unsure", although estimates for this comparison were imprecise because of the small number of participants reporting non-concordant care.

Table 6 Multinomial logistic regression analysis of factors associated with perceived goal-concordant care (N=315)

Comparison Groups	Variable (Reference Group)	*Beta*	*SE*	*Wald c^2*	*p*	*OR*	*95% CI*
Yes VS. Unsure	Intercept	0.777	0.322	5.824	0.016	-	-
	Mechanical ventilation (Ref: Yes)	0.524	0.411	1.623	0.203	1.689	0.754-3.783
	Surgery (Ref: Yes)	-0.042	0.355	0.014	0.905	0.959	0.478-1.921
	Previous ICU care experience (Ref: Yes)	0.840	0.341	6.060	0.014	2.316	1.187-4.519
No VS. Unsure	Intercept	-2.374	1.044	5.171	0.023	-	-
	Mechanical ventilation (Ref: Yes)	-0.563	1.201	5.171	0.639	0.569	0.054-5.991
	Surgery (Ref: Yes)	-1.396	0.894	2.436	0.119	0.248	0.043-1.429
	Previous ICU care experience (Ref: Yes)	1.870	1.080	2.997	0.083	6.486	0.781-53.857

Abbreviations: SE, standard error; OR, odds ratio; CI, Confidence Interval.

Associations Among Decision Quality Indicators

Spearman correlation analyses (Table 7) demonstrated a moderate negative association between FSICU-DM and DRS (r=−0.439, p<0.01), indicating that higher satisfaction with the decision-making process was associated with lower decision regret.

A weak negative association was observed between FSICU-DM and perceived goal-concordant care (r=−0.145, p<0.01). Given that goal-concordant care was coded ordinally (1=concordant, 2=non-concordant, 3=unsure), this finding indicates that greater perceived goal concordance was associated with higher decision satisfaction. No statistically significant association was observed between DRS and goal-concordant care (r = 0.052, p>0.05).

Table 7 Correlations among FSICU-DM, DRS, and goal-concordant care

Variable	FSICU-DM	DRS	Goal-concordant care
FSICU-DM	1.000		
DRS	-0.439**	1.000	
Goal-concordant care	-0.145**	0.052	1.000

Abbreviations: FSICU-DM, decision-making subscale of the Family Satisfaction in the Intensive Care Unit survey; DRS, decision regret scale. ** *P*0.01

Discussion

Main Findings

This study provides a comprehensive examination of surrogate decision quality in neurocritical care for stroke patients by jointly assessing decision satisfaction, decision regret, and perceived goal-concordant care. Although overall decision satisfaction was high, it was statistically significantly associated with clinical severity and socioeconomic context. In contrast, decision regret was common and more strongly associated with markers of illness severity and treatment escalation, particularly transitions in treatment status. Most surrogate decision-makers perceived care to be goal-concordant, yet a substantial proportion expressed uncertainty. Importantly, decision satisfaction and decision regret were moderately and inversely related, whereas goal-concordant care showed a weaker but significant association with decision satisfaction. Together, these findings empirically support a multidimensional conceptualisation of surrogate decision quality that distinguishes decisional processes from decisional outcomes while acknowledging their interdependence.

Decision Satisfaction: A Process-oriented Indicator

Surrogate decision-makers in this study reported relatively high levels of decision satisfaction, with a mean FSICU-DM score of 86.15. This level is comparable to, and in many cases higher than, scores reported in prior ICU studies using the FSICU instrument, which typically range from the low 70s to high 80s [5, 21, 37-39]. One possible interpretation of the comparatively high satisfaction observed in this study is the cultural emphasis on interpersonal harmony in China, which may influence how respondents interpret and report care experiences [40]. This interpretation is consistent with cross-cultural research suggesting that satisfaction ratings may reflect not only care quality but also culturally shaped norms regarding relational evaluation and conflict avoidance [41, 42].

Despite high overall decision satisfaction, the lowest-scoring FSICU-DM item concerned having sufficient time to express concerns and receive answers. This finding mirrors prior studies [43, 44] and underscores the persistent challenge of achieving meaningful communication in the time-pressured environment of neurocritical care, where clinical urgency often constrains deliberation.

A counterintuitive but noteworthy finding was that lower-income families reported higher decision satisfaction. In China's largely out-of-pocket healthcare system, financial considerations play a central role in treatment decisions [28]. It is possible that financial constraints influence how treatment options and

trade-offs are discussed, shaping families' perceptions of support and involvement. However, this explanation remains speculative and warrants further investigation, including qualitative work with healthcare professionals. This finding highlights the contextual sensitivity of decision satisfaction and cautions against interpreting it as a straightforward proxy for objectively "better" decision-making without attention to structural and cultural influences.

Consistent with prior work, patient and family characteristics explained limited variance in satisfaction. In neurocritical care, Weber *et al.* [14] reported no associations between satisfaction and demographic characteristics, with only the number of family meetings attended showing a significant effect. Similarly, a Swiss multicentre ICU study failed to identify any demographic predictors of satisfaction [21]. Taken together, these findings reinforce that decision satisfaction is primarily shaped by modifiable process factors—particularly communication quality, inclusion, and emotional support—rather than by static characteristics. Accordingly, efforts to improve satisfaction should focus on how decisions are supported rather than on identifying "high-risk" demographic groups.

Decision Regret: An Outcome-oriented Indicator

Decision regret was prevalent in this cohort, with over 60% of surrogates reporting some degree of regret and nearly one-third experiencing moderate to severe regret. These levels exceed those reported in prior systematic reviews of healthcare decision regret [22, 23] and in several ICU and stroke-related studies [5, 6, 8, 9]. Prior research suggests that formal advance medical directives are associated with lower DRS scores [6]. In China, however, advance directives and advance care planning remain uncommon [45], which may partially explain the elevated levels of regret observed, as surrogates are often required to make high-stakes decisions without explicit guidance regarding patient preferences.

Consistent with regret theory [24], higher regret was associated with haemorrhagic stroke, nasoenteric tube feeding, and—most prominently—transitions in treatment status. These findings suggest that regret is more strongly linked to decisional outcomes and their downstream consequences than to the decision-making process itself. Transitions in treatment status often occur in response to worsening prognosis, treatment failure, or resource constraints and may intensify counterfactual thinking and self-blame, thereby increasing vulnerability to regret. Prior studies have similarly reported higher regret among surrogates involved in decisions to limit life-sustaining treatment or initiate palliative care [8]. In neurocritical care, where treatment restrictions frequently precede death, surrogates face intense emotional burden and moral responsibility [46]. These findings underscore the importance of providing clear prognostic information, explicit discussion of uncertainty, and sustained emotional support when treatment goals shift.

Unlike some longitudinal studies [8, 9], this study did not find an association between functional status at discharge and decision regret. This discrepancy may reflect differences in timing, outcome definitions, or cultural interpretations of disability and survival. The optimal timing for assessing decision regret and its trajectory over time remains unclear [6], underscoring the need for longitudinal research to examine how regret evolves as outcomes stabilise and meaning-making processes unfold.

Methodologically, this study did not target a single predefined decision but instead asked participants to identify the most challenging decision encountered during neurocritical care. Because decision regret scales are designed to assess reactions to a specific decision, clearer specification of the "index decision" is essential for improving comparability across studies. Existing research encompasses a broad range of decision types (e.g., emergency interventions, life-sustaining treatment, and discharge decisions) [5, 6, 8, 9, 22, 47], complicating cross-study interpretation. Given the strong association observed between treatment status transitions and regret, future research focusing specifically on decisions to limit life-sustaining treatment is particularly warranted.

Goal-concordant Care: Normative Alignment Under Uncertainty

Achieving goal-concordant care is widely regarded as a central aim of high-quality critical care and a key normative indicator of decision quality [11, 48]. This study contributes by incorporating goal-concordant care as a necessary but insufficient component of surrogate decision quality assessment. In neurocritical care, however, goal concordance is inherently difficult to assess due to prognostic uncertainty, sudden loss of patient decisional capacity, and limited prior discussion of care preferences [25]. In China, these challenges are compounded by cultural reluctance to discuss death and the absence of formal advance directives, limiting the feasibility of objective assessment approaches recommended in other contexts [26]. Accordingly, this study relied on surrogate perceptions as the basis for evaluating goal concordance.

Although most surrogates perceived care as goal-concordant (78.4%), nearly one in six expressed uncertainties. Prior ICU caregiving experience was significantly associated with perceived goal-concordant care, with surrogates who had prior ICU experience reporting lower levels of goal concordance and greater uncertainty than those without such experience. One possible interpretation is that previous exposure to ICU care may heighten awareness of the burdens, trade-offs, and limitations of intensive treatment, prompting surrogates to adopt a more critical or cautious perspective when evaluating whether care aligns with the patient's values and preferences. Surrogates of patients who underwent surgery or received mechanical ventilation also more frequently reported perceived goal discordance; however, these associations were not statistically significant after adjustment in the multivariable analysis. Together, these findings underscore the complexity of assessing goal-concordant care in neurocritical care and highlight the importance of ongoing communication, explicit discussion of uncertainty, and repeated clarification of care goals as treatment and prognosis evolve.

Notably, prior discussion of care goals was not associated with any decision quality indicators. This likely reflects the informal and non-specific nature of such discussions in the Chinese context. Importantly, even in settings with mature advance care planning infrastructures, evidence for a consistent positive effect on goal-concordant care remains limited [49]. These findings should therefore be interpreted as reflecting the inherent complexity of goal alignment rather than as evidence of decisional failure.

Integrating Decision Quality Indicators

A central contribution of this study is the empirical demonstration that decision satisfaction, decision regret, and goal-concordant care capture distinct yet interrelated dimensions of surrogate decision quality. These indicators reflect different evaluative lenses and operate at different temporal and conceptual levels. Decision satisfaction is primarily process-oriented, reflecting how decisions are made and experienced in real time. Decision regret is outcome-oriented and emotionally driven, emerging as consequences unfold and alternative choices are retrospectively imagined. Goal-concordant care represents a normative judgment about value alignment that may be only partially observable in practice.

These indicators may diverge in predictable ways. A surrogate may report high satisfaction with communication and support yet experience regret following an unfavourable outcome. Conversely, care may be perceived as goal-concordant while the decision-making process itself feels rushed or insufficiently supportive. In high-uncertainty settings such as neurocritical stroke care—where outcomes are often poor regardless of decision quality—reliance on any single indicator risks mischaracterizing the decision-making experience and obscuring opportunities for targeted intervention.

The moderate inverse association between satisfaction and regret suggests overlapping psychological processes, yet their distinct associations with clinical factors highlight meaningful differences. Satisfaction was more responsive to communicative and contextual aspects of care, whereas regret was more closely linked to illness severity and treatment escalation. The weaker associations involving goal-concordant care further illustrate the challenges of assessing value alignment under conditions of uncertainty. Together, these findings support a multidimensional framework for evaluating surrogate decision quality that integrates, rather than substitutes among, complementary indicators.

Implications for Clinical Practice

These findings underscore the importance of prioritizing communication quality and decisional support in neurocritical care for stroke patients. Interventions that enhance clarity, allow sufficient time for questions, and explicitly acknowledge emotional burden may improve decision satisfaction and potentially reduce regret, even when outcomes are unfavourable. Particular attention should be directed toward families navigating transitions in treatment status, where vulnerability to regret is greatest. Efforts to promote goal-concordant care should extend beyond one-time discussions toward ongoing, iterative conversations that explicitly address uncertainty and evolving prognostic information.

Implications for Research and Decision Science

From a decision science perspective, this study provides empirical support for distinguishing between process-oriented and outcome-oriented indicators of decision quality in surrogate decision-making. Future research should adopt longitudinal designs to examine how these indicators evolve over time and interact with clinical outcomes. In addition, qualitative research is needed to explore the mechanisms underlying the empirical associations observed in this study, including how contextual factors, communication practices, and institutional norms shape surrogate experiences of satisfaction, regret, and perceived goal concordance. Methodologically, clearer specification of the decisional target assessed by regret measures is essential for improving interpretability and comparability across studies. Conceptually, these findings reinforce the value of frameworks that explicitly accommodate uncertainty, emotional burden, and constrained agency—features central to surrogate decision-making but underrepresented in traditional decision models.

Strengths and Limitations

This study is among the first to jointly examine decision satisfaction, decision regret, and perceived goal-concordant care in neurocritical care within an explicit conceptual framework. Strengths include a relatively large sample and the use of validated instruments. Several limitations should be acknowledged. First, the cross-sectional design and single-centre setting limit causal inference and generalizability. Second, assessments of goal-concordant care relied on surrogate report rather than objective verification of patient values. Third, although decision antecedent variables were selected based on prior literature and consultation with clinical experts, they may not capture all relevant contextual, interpersonal, or institutional factors influencing surrogate decision quality, including unmeasured or currently unrecognized variables.

Conclusion

Surrogate decision quality in neurocritical care for patients with stroke is inherently multidimensional, encompassing experiential, emotional, and normative components. By integrating decision satisfaction, decision regret, and goal-concordant care within a unified conceptual framework, this study advances empirical understanding of surrogate decision-making while contributing conceptual clarity to the assessment of decision quality in high-stakes clinical contexts. For critical care nursing, recognising these distinct dimensions may help identify families requiring additional informational, emotional, or decisional support and inform more responsive, family-centred care.

Declarations

- We confirm that this manuscript adheres to the *Neurocritical Care Instructions for Authors*.
- Author Contributions
- Hui Zhang: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing-original draft.
- Carmel Davies: Conceptualization, Methodology, Formal analysis, Supervision, Validation, Writing, review & editing.
- Wenhui Cao: Data curation, Investigation, Resources, Project administration.
- Chunhai Su: Data curation, Investigation, Formal analysis, Resources.
- Deirdre O'Donnell: Conceptualization, Methodology, Formal analysis, Principal Supervision, Validation, Writing, review & editing.All authors meet the authorship criteria and have read and approved the final version of the manuscript.

- The authorship requirements have been met and the final manuscript was approved by all authors.
- This manuscript has not been published elsewhere and is not currently under consideration by another journal.
- Ethical approval was granted by the Ethics Committee of Jining No.1 People's Hospital (Approval No. KYLL-202312-223) and the Research Ethics Committee of University College Dublin (Reference No. LS-24-72-Zhang-ODon).
- We declare that there are no conflicts of interest associated with this study.
- This manuscript is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. The completed checklist has been uploaded as a supplementary file.
- This study received no external funding.

Data Availability

The data supporting the findings of this study are not publicly available due to privacy and ethical restrictions. Data may be made available from the corresponding author (HZ) upon reasonable request, subject to approval from the ethics committees of Jining No.1 People's Hospital and University College Dublin.

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Consent to Participate

Informed consent was obtained electronically. When participants accessed the online survey platform, an informed consent statement was displayed on the survey homepage. Participants were required to review the information and indicate consent by selecting "Yes" before proceeding. Completion and submission of the survey constituted consent to participate in the study.

Declaration of Generative AI Use

During the preparation of this work, the authors used OpenAI ChatGPT to assist with language editing and refinement. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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Figures

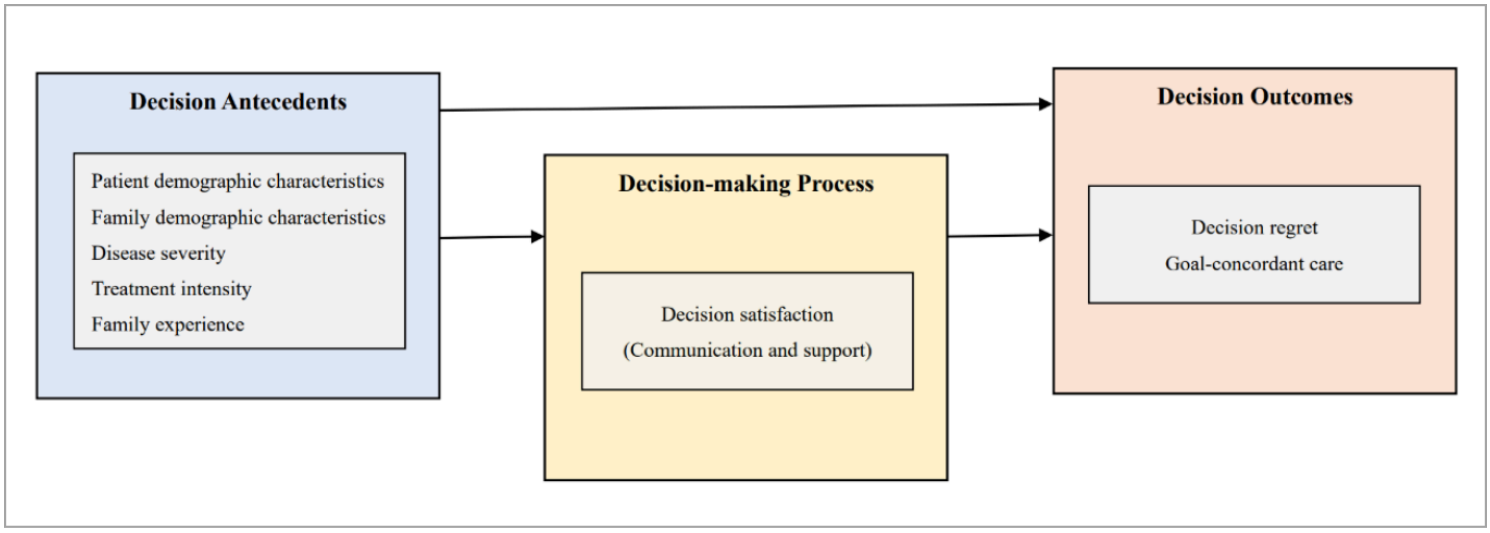

Figure 1

Conceptual framework of surrogate decision quality in neurocritical care.

The framework illustrates how decisional antecedents (patient characteristics, clinical severity, treatment intensity, and family experience) shape surrogate decision-makers' perceived decision-making process (decision satisfaction) and influence downstream decision outcomes, including decision regret and perceived goal-concordant care. Arrows indicate hypothesised direct and indirect relationships among constructs.

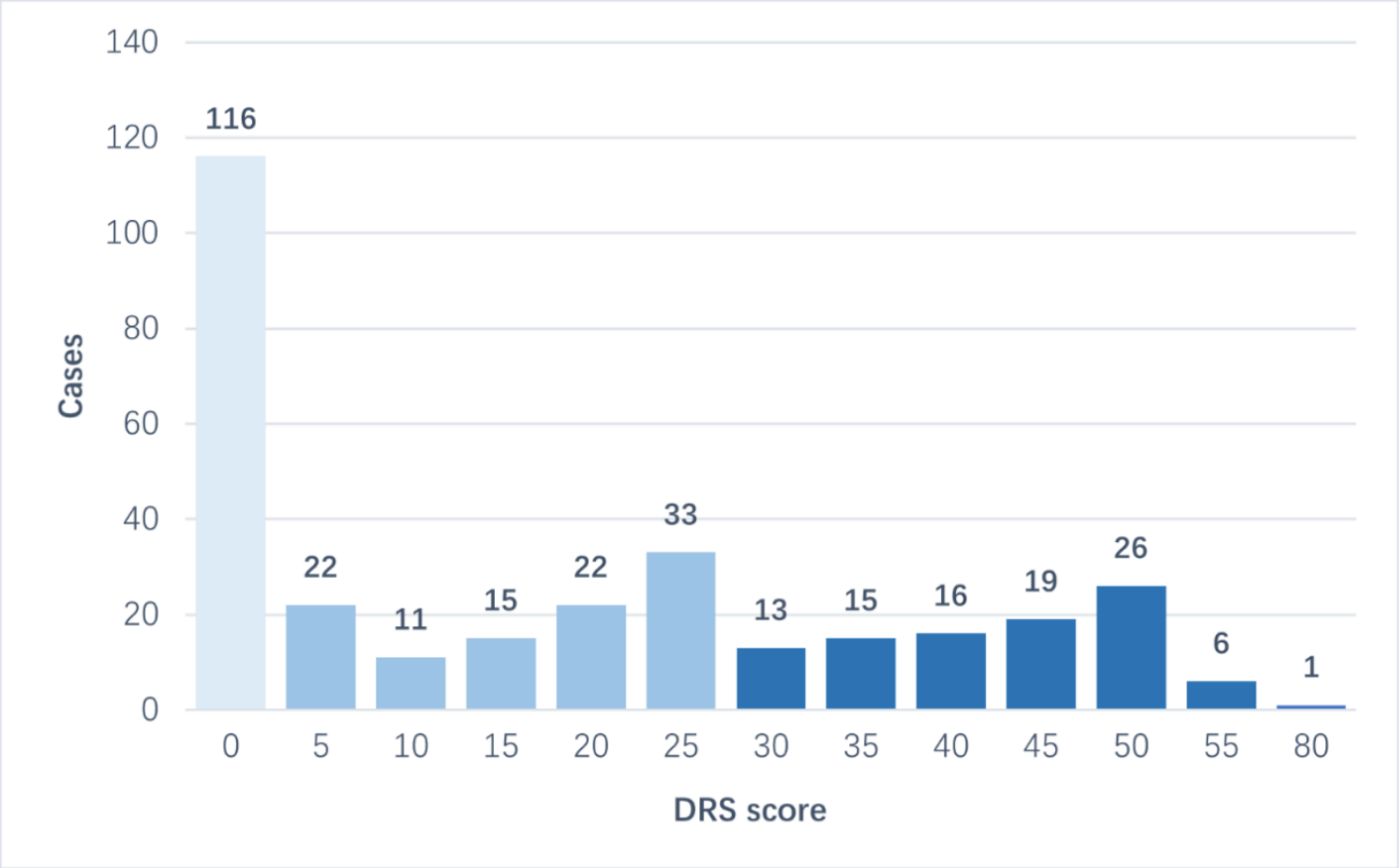

Figure 2

Distribution of DRS scores among surrogate decision-makers.

Bars show the number of surrogate decision-makers at each Decision Regret Scale (DRS) score. Higher scores indicate greater regret regarding the most challenging medical decision identified during neurocritical care. Shading distinguishes no regret (DRS=0), mild regret (DRS=5–25), and moderate-to-severe regret (DRS ≥30).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- STROBEchecklistcrosssectional.docx
- SupplementaryTableS1.docx
- SupplementaryTableS2.docx
- SupplementaryTableS3.docx