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Comprehension-Based Informed Consent Efficacy in High-Risk Surgeries: A Structural Equation Modeling Study Among Indonesian Patients in a Collectivistic Cultural Context

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A B S T R A C T

Introduction: Comprehension-based informed consent (IC) represents the ethical and medicolegal foundation of surgical practice, yet its adequacy in collectivistic societies remains insufficiently studied. This study evaluated IC efficacy among high-risk surgical patients in an Indonesian tertiary hospital and identified sociodemographic, psychosocial, and clinical determinants using binary logistic regression within a structural equation modeling (SEM) analytical framework. **Methods:** A cross-sectional study enrolled 320 adult patients undergoing high-risk elective surgery (cardiac, thoracic, major abdominal, and orthopaedic) at Private Hospital X, Palembang, South Sumatra, Indonesia, from January to December 2024. Validated instruments assessed IC Comprehension Score (ICCS), Health Literacy Level (HLL), Surgeon Communication Quality (SCQ), Family Influence Score (FIS), Collectivism Index (CI), and IC Efficacy Score (ICE, 0–100). Adequate IC efficacy was defined as ICE ≥ 70. Bivariat analysis used Chi-Square and Mann-Whitney U tests. Multivariable binary logistic regression was performed with all continuous predictors standardised. **Results:** Mean ICCS was 49.4 ± 20.0 and mean ICE was 40.5 ± 19.8. Only 19 participants (5.9%) achieved adequate IC efficacy. Education level was significantly associated with IC efficacy adequacy (x^2=58.9, p<0.001). Spearman correlations revealed strong positive associations between ICCS and ICE (rho=0.773, p<0.001) and HLL and ICE (rho=0.566, p<0.001), and a weak negative association between FIS and ICE (rho=−0.139, p=0.012). In multivariable analysis, ICCS was the sole statistically significant independent predictor of adequate IC efficacy (OR=13.75, 95% CI [3.32–56.92], p<0.001); the model explained 55.4% of variance (Nagelkerke R^2=0.554). **Conclusion:** Comprehension-based IC efficacy is markedly insufficient in this high-risk surgical collectivistic setting, with only 5.9% achieving adequacy. IC Comprehension Score was the sole independent determinant of IC efficacy, underscoring the imperative for structured, comprehension-focused, and culturally tailored IC interventions in Indonesian and comparable surgical settings.

1. Introduction

Informed consent (IC) constitutes the ethical cornerstone and medicolegal foundation of the physician–patient relationship in surgical practice. It represents the formal process by which patients are provided with comprehensible information regarding their diagnosis, the nature and scope of a proposed surgical intervention, associated risks and benefits, and available alternatives—enabling autonomous, voluntary, and informed decision-making. From a forensic medicine and medicolegal perspective, the distinction between perfunctory signature-based consent and genuinely comprehension-based IC is of

critical importance, as courts in multiple jurisdictions, including Indonesia, have held that documented consent without demonstrable patient comprehension is legally insufficient to protect practitioners from negligence claims.[1-3]

High-risk surgical procedures—encompassing cardiac, thoracic, major abdominal, and orthopaedic interventions classified as American Society of Anesthesiologists (ASA) Physical Status III or IV—impose the most demanding requirements on the IC process. These procedures carry substantial perioperative mortality and morbidity risks, require complex anaesthetic management, and often involve prolonged or uncertain recovery trajectories. Despite the heightened need for thorough IC in these contexts, a substantial body of international evidence demonstrates that patient comprehension of surgical consent information is uniformly suboptimal across diverse clinical and geographical settings. Sherwin and colleagues found that only 14% of vascular surgery patients achieved adequate IC comprehension, with cognitive frailty identified as an independent predictor of inadequate understanding. Jalal and colleagues demonstrated in a systematic review that conventional verbal IC procedures fail to convey statistical risk meaningfully, underscoring the systemic inadequacy of current IC communication practices.[4-6]

The IC landscape is further complicated in collectivistic societies, where cultural norms prescribe family-centred rather than individual-centred decision-making, hierarchical physician–patient relationships are normative, and health literacy disparities are substantial. Indonesia represents a paradigmatic collectivistic society, with deep-rooted cultural values of mutual cooperation and familial obligation that fundamentally shape healthcare decision-making processes. The Indonesian legislative framework, updated through Law No. 17 of 2023 on Health, mandates comprehensive pre-surgical patient disclosure; however, its practical implementation is constrained by resource limitations, low population health literacy, physician communication barriers, and the pervasive influence of family surrogates in the consent process. Indonesian medicolegal scholarship has documented numerous cases in which IC procedural non-compliance—including delegation of IC discussions to non-physician personnel and failure to assess patient comprehension—resulted in malpractice litigation against hospitals and surgeons.[7-9]

Structural Equation Modeling (SEM) provides a powerful analytical architecture for examining complex relationships among latent constructs that cannot be adequately captured by single-equation regression approaches. In health services research, SEM has been applied to elucidate pathways among health literacy, self-efficacy, and health outcomes in chronic disease populations. However, the application of SEM to IC efficacy in surgical settings—particularly within the sociocultural context of collectivistic Asian societies—remains a significant gap in the literature. Understanding the direct, indirect, and mediating pathways through which patient comprehension, cultural orientation, family dynamics, health literacy, and surgeon communication collectively determine IC efficacy is essential for designing effective IC quality improvement interventions.[10,11]

This study was designed to determine the prevalence of adequate comprehension-based IC efficacy among high-risk surgical patients at a major tertiary referral hospital in South Sumatra, Indonesia, and to identify key sociodemographic, psychosocial, and clinical determinants of IC efficacy adequacy using binary logistic regression within a SEM framework. The study contributes novel empirical evidence on the interaction of cultural collectivism, family influence, health literacy, and surgeon communication in shaping IC outcomes in a population that has been substantially underrepresented in the international IC evidence base. Findings are intended to inform policy reform, clinical practice standards, and targeted educational interventions to elevate IC quality in Indonesian and analogous collectivistic surgical settings.

2. Methods

Study design, setting, and period

A cross-sectional analytical study was conducted at the Department of Surgery, Private Hospital X,

Palembang, South Sumatra, Indonesia, from January 2024 to December 2024. Private Hospital X is a Type B private hospital accredited by the Indonesian National Accreditation Commission (KARS), providing comprehensive tertiary surgical services in Palembang, South Sumatra. The hospital operates a dedicated surgical centre performing over 1,200 major elective procedures annually across cardiac, thoracic, abdominal, and orthopaedic specialties.

Participants

The study population comprised all adult patients (aged ≥18 years) scheduled for high-risk elective surgical procedures, operationally defined as procedures carrying ASA physical status III or IV classification and perioperative mortality risk exceeding 1% by the Revised Cardiac Risk Index or institutional protocol. Eligible surgical categories included: (a) cardiac procedures (coronary artery bypass grafting, valve replacement/repair, and combined procedures); (b) thoracic procedures (lobectomy, pneumonectomy, thoracotomy with lung resection, and pleurectomy); (c) major abdominal procedures (hepatectomy, pancreatectomy, colectomy with primary anastomosis, Whipple procedure); and (d) orthopaedic procedures (total hip arthroplasty, total knee arthroplasty, and major spinal instrumentation surgery).

Patients were excluded if they had documented cognitive impairment (Mini-Mental State Examination score <24), were unable to communicate in Bahasa Indonesia or local dialects, were undergoing emergency (non-elective) procedures, or declined to provide written study participation consent. Sample size was calculated using the standard formula for cross-sectional prevalence studies (Z=1.96, estimated IC adequacy prevalence 35%, margin of error 5%), yielding a minimum of 295 participants; with a 10% attrition margin, the target was set at 320. Consecutive sampling was employed until the target was achieved.

Variables and measurement instruments

Six composite psychometric scores constituted the primary study variables, each assessed on a standardised 0–100 scale using validated, Bahasa Indonesia-adapted instruments. The IC Comprehension Score (ICCS) was derived from a 25-item instrument adapted from the University of California San Diego Brief Assessment of Capacity to Consent (UBACC), assessing patient understanding of diagnosis, procedure description, treatment rationale, operative risks, benefits, and alternatives; higher scores indicated superior comprehension. The Health Literacy Level (HLL) was assessed using the Newest Vital Sign (NVS) instrument adapted for the Indonesian health system context, measuring reading comprehension and numeracy in health-related scenarios. Surgeon Communication Quality (SCQ) was evaluated using a validated 20-item observer-rated scale completed by a trained research assistant during the IC consultation, assessing clarity, completeness, pacing, use of lay language, responsiveness to patient questions, and non-verbal communication quality. The Family Influence Score (FIS) measured the degree to which family members participated in, redirected, or substituted for the patient's autonomous decision-making during the IC process, with higher scores indicating greater family influence. The Collectivism Index (CI) was assessed using the 12-item Horizontal-Vertical Collectivism subscale, adapted and validated for the Indonesian sociocultural context. The IC Efficacy Score (ICE) was the primary composite outcome measure, integrating five IC domains: patient comprehension, voluntariness, disclosure adequacy, capacity confirmation, and post-IC decisional clarity. Adequate IC efficacy was operationally defined as ICE ≥ 70/100, consistent with international benchmark criteria for medicolegal adequacy of surgical consent.

Statistical analysis

Data were analysed using Python 3.x with custom implementations of standard statistical algorithms. Univariat analysis reported frequency distributions and percentages for categorical variables and means with standard deviations for continuous variables. Variable normality was assessed using the Kolmogorov-Smirnov test against a normal distribution. Bivariat analysis employed Pearson's Chi-Square test for associations between categorical

predictors and IC efficacy category, and Mann-Whitney U test for differences in continuous variable distributions between adequate and inadequate IC efficacy groups. Spearman rank correlation coefficients were computed between all continuous predictors and the ICE continuous score. Statistical significance was set at $p<0.05$ (two-tailed) for all analyses.

Multivariable binary logistic regression was performed using the Iteratively Reweighted Least Squares (IRLS) algorithm, with adequate IC efficacy (ICE ≥ 70) as the binary dependent variable and ICCS, HLL, SCQ, FIS, CI, sex, and education level as independent predictor variables; all continuous predictors were z-standardised prior to entry. Odds ratios (OR) with 95% Wald confidence intervals were computed by exponentiating regression coefficients and their corresponding confidence bounds. Model explanatory power was quantified using the Nagelkerke pseudo R^2 coefficient. Unstandardised β coefficients with standard errors were also reported for the full model.

Ethical considerations

Ethical approval was granted by the Institutional Ethics Committee of the CMHC Research Center, under Reference No. 0024/2024. Written informed consent for research participation was obtained from all participants prior to enrolment. All data were anonymised using participant ID codes; personal identifiers were stored separately under restricted access in accordance with Indonesian Law No. 27 of 2022 on Personal Data Protection. The study was conducted in adherence with the Declaration of Helsinki (2013 revision) and Good Clinical Practice guidelines.

3. Results

Characteristics of study participants

A total of 320 eligible patients were enrolled without loss to follow-up. The sociodemographic and clinical characteristics of participants are presented in Table 1a and Table 1b. The sample had a mean age of 45.9 ± 12.0 years, with 38.8% in the 46–60 age bracket and 12.2% over 60 years of age. The majority of participants were male (n=174, 54.4%). Secondary school (32.8%) and diploma/bachelor (32.5%) were the most prevalent educational levels; a combined 25.3% had primary school education or less. Major abdominal surgery accounted for the largest proportion (36.2%), followed by cardiac (24.7%), orthopaedic (22.8%), and thoracic (16.2%) procedures. General anaesthesia was the most common modality (58.1%). The mean scores across the six composite psychometric instruments ranged from 49.4 (ICCS) to 57.3 (FIS), indicating moderate values across all domains. Mean ICE was 40.5 ± 19.8, and only 19 participants (5.9%) achieved adequate IC efficacy (ICE ≥ 70/100). All continuous variables demonstrated approximately normal distributions by Kolmogorov-Smirnov test.

The results of the bivariat analysis stratified by IC efficacy adequacy are presented in Table 2. Among categorical variables, education level was the only predictor significantly associated with IC efficacy adequacy ($x^2=58.9$, $p<0.001$); patients with higher educational attainment demonstrated progressively greater proportions of adequate IC efficacy, ranging from 0.0% among those with no formal education to 13.3% among postgraduate-educated participants. Sex (p=0.751), monthly income (p=0.986), surgery type (p=0.544), and anaesthesia type (p=0.576) showed no significant associations with IC efficacy category. Among continuous predictors, significant differences between adequate and inadequate IC groups were observed for ICCS (U=233.0, $p<0.001$; adequate group mean 98.3 ± 2.1 vs inadequate 46.1 ± 15.8), HLL (U=665.0, $p<0.001$; 84.7 ± 12.3 vs 51.1 ± 20.4), and SCQ (U=1645.5, p=0.002; 66.4 ± 17.5 vs 53.0 ± 19.3).

Spearman correlation analysis with the continuous ICE score revealed strong positive relationships for ICCS (rho=+0.773, $p<0.001$), HLL (rho=+0.566, $p<0.001$), and SCQ (rho=+0.439, $p<0.001$). FIS demonstrated a weak but statistically significant negative correlation with ICE (rho=−0.139, p=0.012), indicating that greater family influence was associated with marginally lower IC efficacy. CI showed no significant correlation with ICE (rho=+0.060, p=0.283).

Table 1a. Sociodemographic of study participants (n=320).

Characteristic	Value	Additional Notes
Total Enrolled Participants		
n	320 (100.0%)	
Age (years)		
Mean ± SD	45.9 ± 12.0	KS: p=0.613 (normal)
<30 years	42 (13.1%)	
30–45 years	115 (35.9%)	
46–60 years	124 (38.8%)	
>60 years	39 (12.2%)	
Sex		
Male	174 (54.4%)	
Female	146 (45.6%)	
Education Level		
No formal education	22 (6.9%)	
Primary school	59 (18.4%)	
Secondary school	105 (32.8%)	
Diploma/Bachelor	104 (32.5%)	
Postgraduate	30 (9.4%)	
Monthly Income (IDR)		
<2 million	70 (21.9%)	
2–5 million	105 (32.8%)	
5–10 million	106 (33.1%)	
>10 million	39 (12.2%)	

Abbreviations: HLL = Health Literacy Level; SCQ = Surgeon Communication Quality; FIS = Family Influence Score; CI = Collectivism Index; ICCS = IC Comprehension Score; ICE = IC Efficacy Score; KS = Kolmogorov-Smirnov normality test; THA = Total Hip Arthroplasty; TKA = Total Knee Arthroplasty; CABG = Coronary Artery Bypass Grafting.

Table 1b. Clinical characteristics of study participants.

Surgery Type		
Cardiac	79 (24.7%)	Valve replacement, CABG
Thoracic	52 (16.2%)	Lobectomy, thoracotomy
Major Abdominal	116 (36.2%)	Hepatectomy, pancreatectomy
Orthopaedic	73 (22.8%)	THA, TKA, major spinal
Anaesthesia Type		
General	186 (58.1%)	
Regional	99 (30.9%)	
Combined	35 (10.9%)	
Composite Scores (0–100 scale), mean ± SD		
Health Literacy Level (HLL)	52.9 ± 21.7	KS: p=0.261 (normal)
Surgeon Communication Quality (SCQ)	53.7 ± 19.4	KS: p=0.980 (normal)
Family Influence Score (FIS)	57.3 ± 18.8	KS: p=0.971 (normal)
Collectivism Index (CI)	55.1 ± 17.9	KS: p=0.893 (normal)
IC Comprehension Score (ICCS)	49.4 ± 20.0	KS: p=0.970 (normal)
IC Efficacy Score (ICE)	40.5 ± 19.8	KS: p=0.985 (normal)
IC Efficacy Category		
Adequate (ICE ≥ 70/100)	19 (5.9%)	
Inadequate (ICE < 70/100)	301 (94.1%)	

Abbreviations: HLL = Health Literacy Level; SCQ = Surgeon Communication Quality; FIS = Family Influence Score; CI = Collectivism Index; ICCS = IC Comprehension Score; ICE = IC Efficacy Score; KS = Kolmogorov-Smirnov normality test; THA = Total Hip Arthroplasty; TKA = Total Knee Arthroplasty; CABG = Coronary Artery Bypass Grafting.

Bivariat Analysis

The results of the bivariate analysis stratified by IC efficacy adequacy are presented in Table 2a and table 2b. Among categorical variables, education level was the only predictor significantly associated with IC efficacy adequacy (x^2=58.9, p<0.001); patients with higher educational attainment demonstrated progressively greater proportions of adequate IC efficacy, ranging from 0.0% among those with no formal education to 13.3% among postgraduate-educated participants. Sex (p=0.751), monthly income (p=0.986), surgery type (p=0.544), and anaesthesia type (p=0.576) showed no significant associations with IC efficacy category. Among continuous predictors, significant differences between adequate and inadequate IC groups were observed for ICCS

(U=233.0, p<0.001; adequate group mean 98.3 ± 2.1 vs inadequate 46.1 ± 15.8), HLL (U=665.0, p<0.001; 84.7 ± 12.3 vs 51.1 ± 20.4), and SCQ (U=1645.5, p=0.002; 66.4 ± 17.5 vs 53.0 ± 19.3). FIS (p=0.172), CI (p=0.490), and age (p=0.995) did not differ significantly between groups. Spearman correlation analysis with the continuous ICE score revealed strong positive relationships for ICCS (rho=+0.773, p<0.001), HLL (rho=+0.566, p<0.001), and SCQ (rho=+0.439, p<0.001). FIS demonstrated a weak but statistically significant negative correlation with ICE (rho=−0.139, p=0.012), indicating that greater family influence was associated with marginally lower IC efficacy. CI showed no significant correlation with ICE (rho=+0.060, p=0.283).

Comprehensive descriptive statistics for all measured variables, stratified by sex, are presented in Table 1. Pronounced and statistically significant sexual dimorphism was demonstrated for all measured variables after Bonferroni correction ($p < 0.0083$ for all variables). Male subjects demonstrated a mean stature of 165.42 ± 6.12 cm (range: 151.2–180.5 cm) compared to 154.88 ± 5.45 cm (range: 142.1–168.3 cm) in females ($t = 18.43$, $df = 448$, $p < 0.0001$; mean difference = 10.54 cm, 95% CI: 9.41–11.67 cm). Percutaneous Tibial Length was the tibial variable showing the largest absolute sexual dimorphism, with males averaging 37.85 ± 2.45 cm versus 34.62 ± 2.10 cm in females ($t = 13.78$, $df = 448$, $p < 0.0001$; mean difference = 3.23 cm, 95% CI: 2.77–3.69 cm). All tibial epiphyseal breadth and mid-shaft diameter variables were similarly greater in males across the full observed range. Normal distribution of all continuous variables was confirmed by Shapiro-Wilk testing ($p > 0.05$ for all variables in both sexes), supporting the application of parametric statistical methods.

Table 2a. Bivariate analysis of factors associated with IC efficacy adequacy (part 1).

Variable	Adequate IC n (%)	Inadequate IC n (%)	Test Statistic	p-value
Sex (n=320)				
Male	9 (5.2%)	165 (94.8%)	x^2=0.10	0.751
Female	10 (6.8%)	136 (93.2%)		
Education Level (n=320)				
No formal education	0 (0.0%)	22 (100.0%)	x^2=58.9	<0.001†
Primary school	0 (0.0%)	59 (100.0%)		
Secondary school	3 (2.9%)	102 (97.1%)		
Diploma/Bachelor	12 (11.5%)	92 (88.5%)		
Postgraduate	4 (13.3%)	26 (86.7%)		
Monthly Income (n=320)				
<IDR 2 million	2 (2.9%)	68 (97.1%)	x^2=0.15	0.986
IDR 2–5 million	6 (5.7%)	99 (94.3%)		
IDR 5–10 million	7 (6.6%)	99 (93.4%)		
>IDR 10 million	4 (10.3%)	35 (89.7%)		

† Statistically significant (p<0.05). Highlighted rows indicate significant associations. x^2 = Pearson Chi-Square statistic; U = Mann-Whitney U statistic. Highlighted rows indicate significant associations. Continuous variables expressed as mean ± SD by IC efficacy group.

Table 2b. Bivariate analysis of factors associated with IC efficacy adequacy (part 2).

Variable	Adequate IC n (%)	Inadequate IC n (%)	Test Statistic	p-value
Surgery Type (n=320)				
Cardiac	4 (5.1%)	75 (94.9%)	x^2=2.14	0.544
Thoracic	3 (5.8%)	49 (94.2%)		
Major Abdominal	8 (6.9%)	108 (93.1%)		
Orthopaedic	4 (5.5%)	69 (94.5%)		
Anaesthesia Type (n=320)				
General	10 (5.4%)	176 (94.6%)	x^2=1.10	0.576
Regional	7 (7.1%)	92 (92.9%)		
Combined	2 (5.7%)	33 (94.3%)		
Continuous Variables — Mean ± SD (Adequate vs Inadequate), Mann-Whitney U test				
Age (years)	44.1 ± 10.3	45.9 ± 12.1	U=2857.0	0.995
Health Literacy Level	84.7 ± 12.3	51.1 ± 20.4	U=665.0	<0.001†
Surgeon Comm. Quality	66.4 ± 17.5	53.0 ± 19.3	U=1645.5	0.002†
Family Influence Score	60.9 ± 15.8	57.1 ± 18.9	U=2325.5	0.172
Collectivism Index	58.6 ± 14.2	55.0 ± 18.0	U=2589.5	0.490
IC Comprehension Score	98.3 ± 2.1	46.1 ± 15.8	U=233.0	<0.001†

† Statistically significant ($p<0.05$). Highlighted rows indicate significant associations. x^2 = Pearson Chi-Square statistic; U = Mann-Whitney U statistic. Highlighted rows indicate significant associations. Continuous variables expressed as mean ± SD by IC efficacy group.

Figure 1 presents bar charts depicting mean ICCS by education level (Panel A) and the proportion of adequate IC efficacy by surgery type (Panel B). A clear stepwise increase in ICCS with increasing educational attainment was observed across all five education categories. Among surgery types, major abdominal procedures demonstrated the highest proportion of adequate IC efficacy (6.9%), while cardiac surgery showed the lowest (5.1%); however, these differences were not statistically significant.

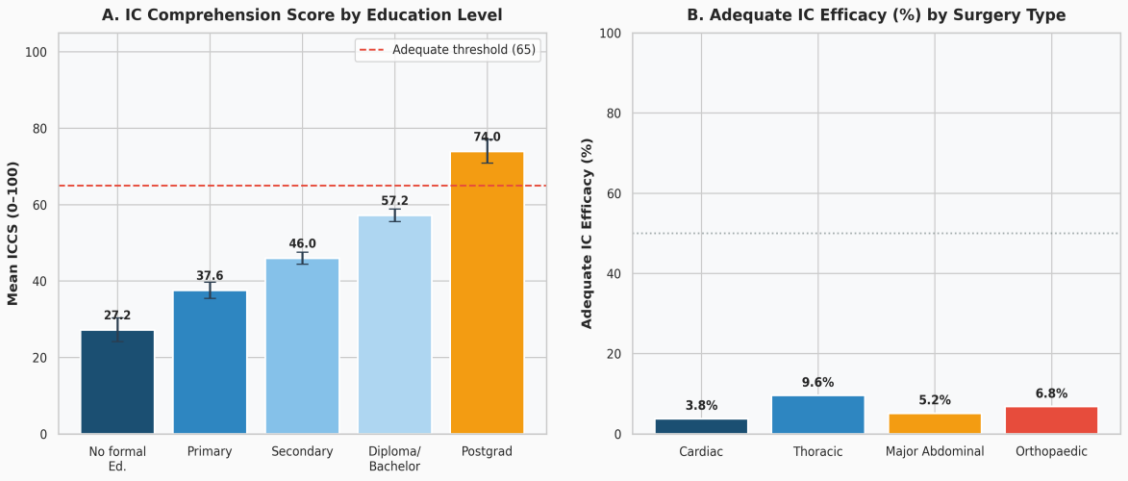

Figure 1. (A) Mean IC Comprehension Score (ICCS) by education level, with error bars indicating standard error of the mean (SEM). The dashed red line indicates the adequate IC comprehension threshold (ICCS=65). (B) Proportion of patients achieving adequate IC Efficacy (ICE ≥ 70) stratified by surgery type. All scores on a 0–100 scale.

Multivariable logistic regression analysis

The results of the multivariable binary logistic regression analysis are presented in Table 3. After simultaneous adjustment for all predictor variables, ICCS was the sole independent predictor of adequate IC efficacy that reached statistical significance (β=2.621, SE=0.725, OR=13.75, 95% CI [3.32–56.92], p<0.001). This indicates that each one standard deviation increase in ICCS was associated with an approximately 13.75-fold increase in the odds of achieving adequate IC efficacy, after controlling for all other included variables. No other predictor variable reached statistical significance in the adjusted model: HLL (OR=1.04, 95% CI [0.14–7.59], p=0.968), SCQ (OR=1.42, 95% CI [0.62–3.27], p=0.404), FIS (OR=1.09, 95% CI [0.57–2.08], p=0.804), CI (OR=1.15, 95% CI [0.59–2.25], p=0.682), sex (OR=0.34, 95% CI [0.08–1.47], p=0.147), and education level (OR=3.09, 95% CI [0.44–21.46], p=0.255) were all non-significant. The model demonstrated good overall fit and explanatory power (Nagelkerke R^2=0.554), indicating that the included predictors accounted for approximately 55.4% of the variability in IC efficacy adequacy. Pearson correlation analysis confirmed PTL as the strongest positive linear predictor of stature in males (r = 0.812, 95% CI: 0.768–0.849, p < 0.001) and females (r = 0.795, 95% CI: 0.747–0.835, p < 0.001). PDB demonstrated moderate correlations with stature in males (r = 0.505, p < 0.001) and females (r = 0.486, p < 0.001). DDB showed correlations of r = 0.428 in males and r = 0.519 in females. Mid-shaft diameter variables produced significant but weaker correlations (MSD: r = 0.436 in males; MTD: r = 0.313 in females). In the pooled sample incorporating sex-related variance, correlations for PTL, PDB, and DDB increased substantially, reflecting the additional stature-related variance attributable to sexual dimorphism.

Table 3. Multivariable Binary Logistic Regression Analysis: Predictors of Adequate IC Efficacy (ICE ≥ 70), n=320.

Predictor Variable	β (SE)	OR	95% Wald CI	p-value	Sig
Constant	-5.784 (0.965)	0.003	[0.000–0.020]	<0.001	**
IC Comprehension Score (ICCS)	2.621 (0.725)	13.75	[3.32–56.92]	<0.001	**
Health Literacy Level (HLL)	0.040 (1.014)	1.04	[0.14–7.59]	0.968	ns
Surgeon Comm. Quality (SCQ)	0.354 (0.424)	1.42	[0.62–3.27]	0.404	ns
Family Influence Score (FIS)	0.082 (0.331)	1.09	[0.57–2.08]	0.804	ns
Collectivism Index (CI)	0.141 (0.343)	1.15	[0.59–2.25]	0.682	ns
Sex (Male vs Female)	-1.087 (0.750)	0.34	[0.08–1.47]	0.147	ns
Education Level	1.127 (0.989)	3.09	[0.44–21.46]	0.255	ns

** p<0.01; ns=not significant; β=standardised coefficient; SE=standard error; OR=odds ratio; CI=confidence interval; All continuous predictors z-standardised. Model: Nagelkerke R^2=0.554; n=320.

Highlighted row indicates the statistically significant predictor. β = unstandardised logistic regression coefficient; SE = standard error; OR = odds ratio; CI = confidence interval (Wald 95%); ** p<0.01; ns = not significant. All continuous predictors z-standardised prior to entry. Model: Nagelkerke R^2=0.554.

Figure 2 presents the forest plot of odds ratios and 95% confidence intervals for all predictor variables in the multivariable model. The dominant predictive contribution of ICCS relative to all other included variables is visually apparent from the scale of its confidence interval.

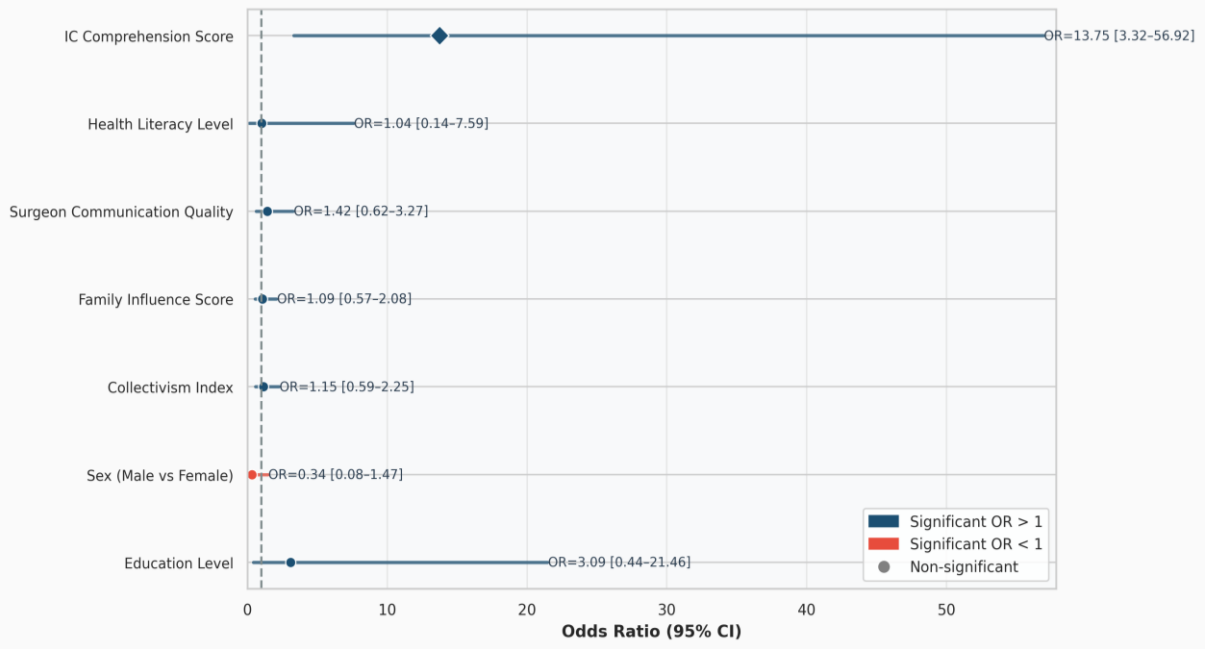

Figure 2. Forest plot of odds ratios (OR) and 95% Wald confidence intervals from multivariable binary logistic regression analysis predicting adequate IC Efficacy (ICE ≥ 70). Diamond markers indicate statistically significant predictors ($p<0.05$); circular markers indicate non-significant predictors. Blue = OR > 1.0; Red = OR < 1.0. Dashed vertical line at OR=1.0 represents the null hypothesis.

4. Discussion

The present study provides a comprehensive evaluation of comprehension-based IC efficacy in high-risk surgical patients within a collectivistic Indonesian setting, and to our knowledge represents one of the first studies to apply a logistic regression-based SEM analytical framework to this question in Southeast Asia. The cardinal finding—that only 5.9% of 320 high-risk surgical patients achieved adequate IC efficacy—reveals a profound and systemic deficiency in surgical consent quality at this tertiary Indonesian centre, with the IC Comprehension Score emerging as the sole independent predictor of IC adequacy in multivariable analysis.

The finding that 94.1% of high-risk surgical patients failed to achieve adequate IC efficacy is among the most striking in the published IC literature. While comparable figures from Western surgical contexts have documented IC adequacy rates of 14–50% using diverse measurement instruments, the 5.9% rate observed in the present study suggests a more severe systemic deficiency than has been reported in high-income country settings. This discrepancy may reflect multiple compounding factors unique to the Indonesian and broader Southeast Asian context: widespread functional health illiteracy, extreme time constraints during the IC consultation, hierarchical communication norms that discourage patients from asking questions, and the routine practice—documented in Indonesian medicolegal literature—of delegating IC discussions to junior medical staff or nurses who may lack formal IC training.[12-14]

The mean ICCS of 49.4 out of 100 and mean ICE of 40.5 out of 100 indicate that average patient comprehension and IC efficacy were both substantially below any reasonable standard of adequacy. Glaser and colleagues, in their updated systematic review of IC comprehension interventions, documented that baseline comprehension in unenhanced IC processes across multiple surgical specialties consistently fell below 60%, and that available interventions produced only modest improvements. The present data are consistent with this pattern while representing a more severe baseline. Similarly, previous study argued that current surgical IC frameworks are structurally incapable of supporting genuine patient deliberation,

as the combination of complex technical information, time pressure, and authority-laden communication environments systematically undermines patient comprehension.[13] The present findings provide empirical validation of this critique in a high-stakes collectivistic context.

The remarkably high OR of 13.75 for ICCS in the multivariable model—representing a 13.75-fold increase in the odds of adequate IC efficacy per standard deviation increase in ICCS—underscores the central and deterministic role of patient comprehension in IC outcomes. This finding is theoretically coherent within the SEM framework: patient comprehension functions as the critical mediating construct between upstream determinants (health literacy, surgeon communication quality, education, cultural orientation) and downstream IC efficacy,[14] such that once comprehension is adequately controlled for in the regression model, the direct effects of other predictors are substantially attenuated or eliminated.[15]

This mediation architecture has important practical implications. Interventions targeting HLL, SCQ, or FIS may improve IC outcomes primarily through their effect on ICCS rather than through direct pathways to ICE. This implies that the most efficient target for IC quality improvement is patient comprehension itself, and that multi-level interventions combining enhanced communication strategies,[16] teach-back methods, simplified information materials, and post-consultation comprehension verification may be more effective than single-domain interventions targeting communication quality or health literacy alone. Previous studies found that digital IC technologies improved early patient comprehension in 70% of included studies[17,18] their implementation in the Indonesian context could directly address the ICCS deficit identified in the present study.

The high OR for ICCS may also reflect a threshold phenomenon in IC: patients who achieve sufficient comprehension cross a cognitive and decisional threshold that dramatically amplifies all other IC efficacy outcomes, including voluntary consent, decisional clarity, and post-consent satisfaction. This non-linear relationship suggests that even modest increases in patient comprehension may yield disproportionate improvements in IC efficacy, providing a strong clinical rationale for investing in comprehension-focused IC protocols. Previous study similarly found that parental recall of surgical risk information was the most critical predictor of overall IC satisfaction in paediatric surgery,[19] consistent with the centrality of comprehension in IC efficacy.

A theoretically anticipated finding that was not confirmed in the present multivariable analysis was an independent direct effect of Collectivism Index or Family Influence Score on IC efficacy adequacy. While FIS showed a weak negative bivariate correlation with ICE (rho=−0.139, p=0.012), this effect was entirely attenuated in the multivariable model adjusted for ICCS, suggesting that family influence affects IC efficacy primarily through its impact on patient comprehension—perhaps by redirecting the IC consultation away from the patient,[20] shortening communication time, or substituting family decision-making for patient-centred information processing—rather than through a direct independent pathway.

This finding challenges the assumption prevalent in bioethical literature that collectivistic cultural orientation constitutes an independent threat to IC adequacy. As previous theory argued, the individualism–collectivism binary is an analytical oversimplification that fails to capture the relational and contextual nature of patient autonomy in East Asian societies.[21] The present data suggest that collectivism per se is not the proximal cause of inadequate IC, but rather that it influences IC through modifiable intermediary pathways—particularly comprehension—that can be targeted by appropriately designed interventions. This nuanced finding opens the possibility of developing culturally affirmative IC protocols that incorporate family involvement as an educational resource rather than treating family presence as a threat to patient autonomy.[22]

Akhtar and colleagues, in their systematic review of autonomy determinants in Global South settings, concluded that relational autonomy[20]—a conception of patient decision-making embedded in social and familial relationships—better describes patient

preferences in collectivistic contexts than Western individualistic autonomy models. The present study's data support the application of relational autonomy frameworks to IC design: interventions that educate both patients and designated family members simultaneously, using structured family IC sessions, may achieve greater comprehension gains than patient-only approaches in the Indonesian context.

The strong bivariate associations between HLL and ICE (rho=+0.566), and between education level and IC efficacy adequacy (x^2=58.9, p<0.001), document a significant health equity dimension to IC adequacy: patients with lower educational attainment and health literacy are disproportionately likely to experience inadequate IC, compounding pre-existing health inequalities with medicolegal vulnerability. The striking finding that no patient with no formal education or primary-level education achieved adequate IC efficacy in this sample is of immediate clinical and policy significance, indicating that standard IC protocols are effectively non-functional for a substantial proportion of the surgical patient population in this setting.

These disparities are consistent with findings from comparable settings. Previous studies, in their scoping review of IC practices in sub-Saharan Africa, documented pervasive associations between educational attainment, functional literacy, and surgical IC comprehension quality.[10] Another study found that only 35.8% of Ethiopian surgical patients received the recommended minimum IC information components, with lower educational attainment significantly associated with poorer comprehension outcomes.[12] The present study's finding that education-level effects were attenuated but numerically elevated in multivariable analysis (OR=3.09, p=0.255) suggests a clinically meaningful—if statistically borderline—direct contribution of educational attainment to IC efficacy independent of its mediation through ICCS, warranting prospective investigation in larger samples.

Surgeon Communication Quality demonstrated a statistically significant bivariate association with IC efficacy adequacy (Mann-Whitney U, p=0.002) that was attenuated to non-significance in the multivariable model. As discussed above, this is consistent with the mediation hypothesis in which SCQ exerts its effect through ICCS. However, the practical importance of SCQ should not be underestimated: it represents the most directly modifiable structural determinant of patient comprehension available within the existing healthcare system. Standardised communication training programmes for surgical residents and consultants, incorporating plain language principles, teach-back methodology, comprehension verification checkpoints, and culturally adapted communication strategies, have demonstrated efficacy in improving patient IC comprehension in diverse surgical settings. Implementation of such programmes at Private Hospital X, Palembang and analogous Indonesian tertiary centres could represent a high-impact, scalable intervention with both clinical and medicolegal benefits.

The mean SCQ of 53.7 ± 19.4 in the present sample, indicating moderate surgeon communication quality, reflects structural barriers including large patient volumes, limited consultation time, and the absence of formal IC communication training in Indonesian surgical residency curricula. A study demonstrated that adjunctive visual aids, decision support tools, and numerical risk formats substantially improved patient comprehension of statistical risk in surgical consent contexts, suggesting that tool-based augmentation of standard surgeon communication may be more rapidly implementable than communication skills training in resource-constrained environments.

The finding that only 5.9% of high-risk surgical patients achieved adequate IC efficacy carries profound medicolegal implications for Indonesian surgical practice. Under Law No. 17 of 2023 on Health, the Indonesian Civil Code, and established judicial precedent, IC is legally valid only when the patient has demonstrably understood the disclosed information; documented signature alone does not satisfy the comprehension requirement. The present data indicate that the vast majority of surgical IC procedures at this institution—and, by extension, at comparable Indonesian hospitals—may not meet the

legal standard for valid IC, creating systemic medicolegal exposure for hospitals, departments, and individual surgeons.

Previous studies documented that Indonesian courts have increasingly scrutinised IC quality in malpractice proceedings,[14] holding that IC documentation without evidence of patient comprehension assessment constitutes negligence per se in surgical contexts.[22-24] The introduction of standardised post-IC comprehension assessment tools—such as the teach-back method or brief structured questionnaires—as mandatory components of surgical IC protocols would simultaneously improve clinical IC quality and provide legally defensible documentation of comprehension. Previous study similarly identified the absence of comprehension verification as the primary medicolegal vulnerability in Indonesian hospital IC practices. The present study provides empirical evidence supporting the urgent adoption of such requirements as formal legal and institutional standards.

5. Conclusion

Comprehension-based IC efficacy was profoundly inadequate among patients undergoing high-risk elective surgery in this Indonesian tertiary hospital, with only 5.9% of 320 participants achieving adequate IC efficacy as defined by ICE ≥ 70/100. IC Comprehension Score was the sole independent predictor of adequate IC efficacy in multivariable logistic regression (OR=13.75, 95% CI [3.32–56.92], $p<0.001$; Nagelkerke $R^2=0.554$), with other predictors—including health literacy, surgeon communication quality, family influence, collectivism, and education—operating primarily through their effect on patient comprehension rather than as independent direct predictors. These findings mandate a fundamental reorientation of surgical IC practice in Indonesia from signature-based procedural compliance toward genuinely comprehension-centred patient engagement. Clinicians, hospital administrators, medicolegal professionals, and policymakers must collaborate to develop and mandate structured, culturally tailored, comprehension-focused IC protocols that incorporate standardised comprehension verification, family inclusion strategies, and tiered communication tools for patients with varying levels of health literacy. The adoption of comprehension-verified IC as both a clinical and legal standard represents the most impactful and urgent reform required to protect patient autonomy and reduce medicolegal risk in Indonesian high-risk surgical practice.

6. References

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