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ORIGINAL RESEARCH

Advancing family-centred care measurement in adult critical care: psychometric testing of the MPOC-SP(A) tool in South Africa

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Abstract

Background: The Measures of Process of Care for Service Providers (MPOC-SP(A)) tool, developed by the CanChild Centre for Childhood Disability Research in Canada, assesses service providers' perceptions of Family Centred Care (FCC) in adult rehabilitation. The study aimed to adapt and validate the MPOC-SP(A) tool for use in adult intensive care units (ICUs) to assess patient- and family-centred care delivery. The original tool consisted of 27 items categorised into four domains: "showing interpersonal sensitivity", "providing general information", "communicating specific information", and "treating people respectfully". Following our initial content validation study, the number of items was reduced to 24. This study, which is the final validation phase of the MPOC-SP(A) tool, aims to evaluate the construct validity and reliability of the tool adapted for adult ICUs (MPOC-SP(A)) in South Africa. **Method**: Following approval from the Human Research ethics committee, a 24-item tool, developed through content validation, was administered to 134 healthcare professionals working in adult ICUs across public and private hospitals in South Africa. Confirmatory factor analysis (CFA) tested the tool's factor structure for goodness-of-fit, and reliability was assessed using Cronbach's alpha and intraclass correlation coefficients (ICC). **Results**: The CFA supported a four-factor structure with acceptable model fit indices. Overall, the tool showed excellent internal consistency ($\alpha = 0.93$), while moderate ICC values indicated adequate test-retest reliability. **Conclusions**: These findings support the MPOC-SP(A) as a culturally sensitive tool for assessing healthcare providers' perceptions of family-centred care (FCC) in South African ICUs.

Keywords

Intensive care units; Family-centered care; Psychometrics

1. Introduction

Family-centred care (FCC) is a partnership between the healthcare provider and the family of a patient to collaboratively determine the process of care for the patient [1]. In the intensive care units (ICUs), the practice of FCC should be standardised in the care of critically ill patients; this approach not only positively affects the patient's well-being but also facilitates emotional and psychological support for the family, who may become overwhelmed by the thought of having a critically ill loved one [1]. Critically ill patients may not be able to voice their opinions about the care they receive, but family members can act as advocates for these patients. Therefore, providing a conducive environment that enables the family to contribute to the care of their loved ones should be encouraged by the healthcare system. This necessitates that healthcare providers be educated on the various dimensions of family-centred care and encouraged to practice them [1].

Despite its recognized benefits, the global practice of FCC in ICUs exhibits considerable variation due to barriers such as manpower shortages, cultural norms, and staff resistance [2]. In South Africa, barriers to FCC implementation in ICUs include communication tensions, limited understanding of FCC principles, and cultural differences [1]. While healthcare professionals express a desire to practice FCC, there is often confusion between a relational approach and a participatory approach. Unlike a relational approach, which focuses on good clinical skills and professional attitudes, a participatory approach prioritizes individualized care, responsiveness to family concerns, and active family involvement in decision-making [3].

Various tools have been developed to assess FCC, primarily from the perspective of family members. The Measures of Process of Care (MPOC) tool is commonly applied to measure family-centered care in paediatric rehabilitation settings [4]. The tool was originally designed to garner information from the perspective of parents of children with disabilities and chronic health conditions regarding the care received from healthcare providers [5, 6]. The tool originally contained 56 items distributed across five factors that assessed key aspects of family-centered care. These factors include: (1) enabling and partnership, (2) providing general information, (3) providing specific information about the child, (4) coordinated and comprehensive care for child and family, and (5) respectful and supportive care [5, 6]. The MPOC tool was further refined for applicability in adult settings and to assess FCC from the perspective of service providers [7, 8]. This adapted version, MPOC-SP(A), was developed with 27 items grouped into four factors: (1) showing interpersonal sensitivity, (2) providing general information, (3) communicating specific information, and (4) treating people respectfully [8]. Although this tool has been used in both paediatric and adult rehabilitation settings in various countries, its validity in assessing FCC in adult ICUs in low- and middle-income countries (LMICs) remains unverified [8–12].

In phase one of this project (Stellenbosch University HREC approval number: N24/03/032), the content of the MPOC-SP(A) tool was validated by six healthcare professionals with expertise in adult critical care in South Africa. The validation process addressed the relevance and clarity of each item within the local South African setting. The content validation index at both the item (I-CVI) and scale (S-CVI/Ave) levels were calculated. An I-CVI of 0.83 and S-CVI/Ave of 0.9 were deemed acceptable. Items with a CVI below 0.83 were discarded. The results of the content validation study led to modifications in the MPOC-SP(A) tool. Consequently, the questionnaire was reduced from 27 to 24 items, with two items revised to enhance clarity [13]. The next stage of the validation process was to establish the construct validity of the tool before its practical implementation.

Reliability is a broad term that examines the degree to which scores remain consistent when respondents are measured repeatedly under various conditions, such as across different sets of items from the same tool (internal consistency), over time (test-retest), by different individuals on the same occasion (interrater reliability), or by the same individuals on different occasions (intra-rater reliability) [14]. Internal consistency measures the degree to which items in a subscale interrelate and is assessed using Cronbach's alpha [15, 16]. A higher Cronbach's alpha value indicates stronger inter-item correlation, whereas poorly correlated items may need to be removed to improve internal consistency [15]. Test-retest reliability evaluates measurement stability by comparing responses across two administrations of the tool, accounting for both within-respondent and between-respondent variance [14]. It is measured using the intra-class correlation coefficient (ICC), a two-way random effects model [14]. Higher reliability values correspond to reduced measurement error [15]. Reliability should be calculated for each subscale of the psychometric tool [14]. This step must be completed before the construct validation process commences [15].

Construct validity assesses how well the items in the tool measure the intended concept [17]. It is determined using confirmatory factor analysis (CFA), which tests hypotheses about the tool's factor structure, particularly when evaluating consistency across different versions or adaptations [18]. This is particularly crucial for tools that have been translated or culturally adapted [18]. In this study, cross-cultural validity—a subtype of construct validity—will be examined. Cross-cultural validity, also known as measurement invariance, determines the extent to which items on a translated or culturally adapted tool reflect the same conceptual performance as the original version [14]. This assessment is crucial when instruments are applied across diverse populations, including variations in ethnicity, language, gender, and age [14]. Cross-cultural validity can be tested using differential item functioning (DIF) analysis, logistic regression analyses, or through multigroup confirmatory factor analysis (MGCFA) to determine equivalence in factor structure and loadings across groups [14]. Ensuring measurement invariance allows for meaningful comparisons of mean scores and parametric statistics across different groups [19, 20].

This study, part of a broader validation effort, investigates the construct validity and reliability of the MPOC-SP(A) within the unique cultural context of South Africa's adult ICUs. The findings will contribute to the development of a culturally sensitive instrument for evaluating healthcare providers' perceptions of FCC. Ultimately, this research will enhance the understanding and implementation of FCC principles in critical care, leading to improved patient and family outcomes.

2. Methods

2.1 Study design and participants

This cross-sectional study included doctors, nurses, and allied health professionals who have work experience in adult intensive care units (ICUs) in South Africa. Patients, administrative staff, and students were excluded from the study. A total of 134 participants from both public and private hospitals in South Africa were recruited. The sample size was calculated as 10% of the total number of participants required for the third phase of this study (national evaluation). This total was calculated using the freely available tool StatCalc by Epi Info™.

Participants completed the 24-item MPOC-SP(A) tool via Research Electronic Data Capture (REDCap). The MPOC-SP(A) was delivered electronically to potential participants via the Critical Care Society of Southern Africa, the researchers' network and at professional conferences. The data were collected between 22 August 2024, and 27 October 2024.

Digitally signed informed consent was obtained from all participants before any online data collection. Participant data were safeguarded by regulations outlined in the Protection of Personal Information (POPI) Act. Codes were utilized to anonymise participant identities, and no personally identifiable information was used during data analysis and dissemination of results.

Participants completed the online survey and were also given the option to participate in a retest, which was used to determine the tool's reliability. The responses received were exported as nominal measurements, where 1 represented "not at all" and 7 represented "to a very high extent". Each item in each domain was coded numerically to simplify the data analysis.

2.2 Data analysis

The data were extracted from REDCap, cleaned, and pre-processed in Microsoft Excel (Version 2506 (Build 16.0.18925.20076), Microsoft Corporation, Redmond, WA, USA) before being transferred to RStudio for further analysis. Descriptive statistics were used to summarise sample characteristics such as age, profession, and years of experience. The mean score and standard deviation were calculated for each domain and individual item.

The factor structure of the 24-item MPOC-SP(A) was examined using confirmatory factor analysis (CFA) by comparing various plausible hypothesised models (Figs. 1,2,3,4,5 below). This was done by comparing the models' respective goodness-of-fit indices to identify which model best represented the test's factor structure and subsequently assessing measurement invariance across groups. The analysis was run in RStudio, following the recommendations given by Fischer *et al*. [20], with the code provided in the **Supplementary material**.

The goodness of fit indices used were:

- A chi-square value below 5;
- Comparative fit index (CFI) and Tucker-Lewis index (TLI) values of 0.90 or greater;
- Root mean square error of approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR) values between 0.03 and 0.08, and;
- A loading factor of at least 0.50 [12, 21–23].

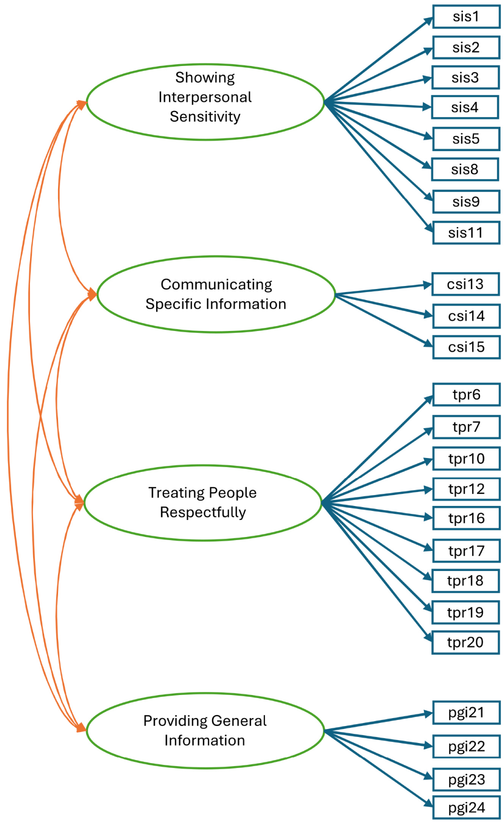

FIGURE 2. Four-factor model.

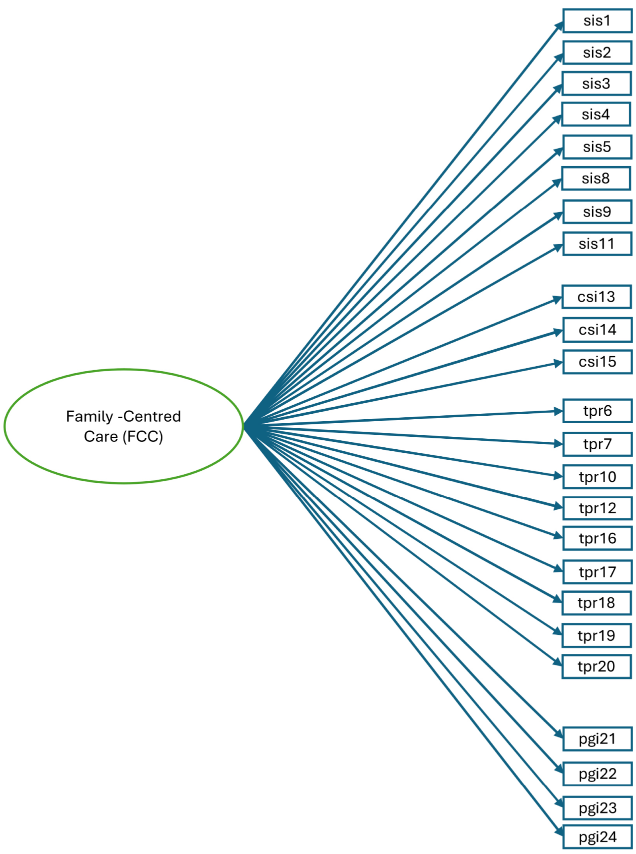

FIGURE 1. Unidimensional model.

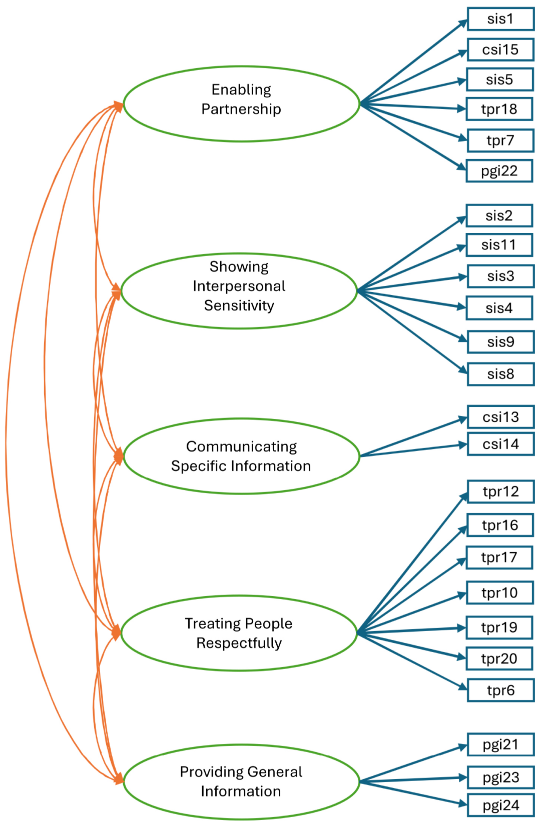

FIGURE 3. Five-factor model.

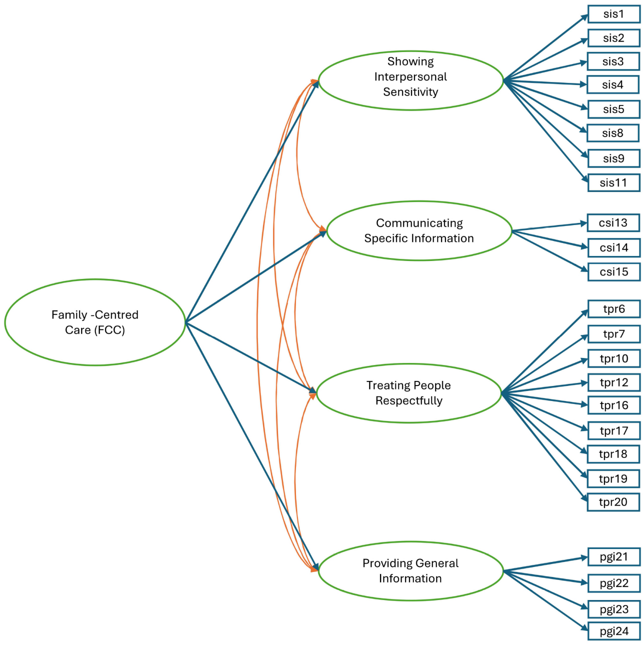

FIGURE 4. 2nd order model (four-factor).

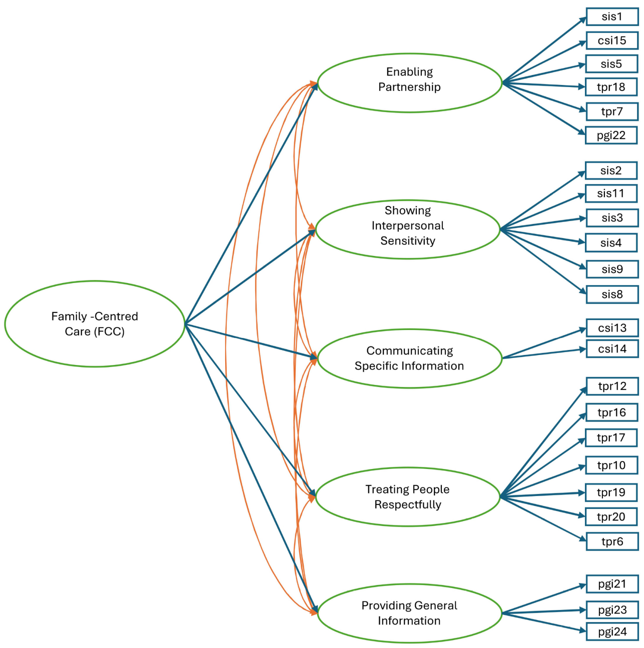

FIGURE 5. 2nd order model (five-factor).

Before CFA, the data underwent normality testing to confirm its suitability for CFA and MGCFA assumptions. Both univariate and multivariate normality were assessed separately for public and private sector participants using item scores. Univariate normality was evaluated using several tests, including the Shapiro-Wilk and Anderson-Darling tests [24, 25]. For multivariate normality, the Mardia test, Henze-Zirkler test, and Quantile-Quantile (Q-Q) plots were applied, all performed using the "MVN" package in R [26–29]. Employing multiple methods aligns with best practices in normality testing, as no single method is considered definitive. Univariate normality does not guarantee multivariate normality; therefore, both assessments were necessary [30, 31]. Detailed results of the normality tests are presented in the **Supplementary material**.

Following CFA, measurement invariance testing was conducted both at the overall sample level and between public and private groups. The adequate factor structure identified through CFA was subjected to increasing levels of invariance constraints, progressing through configural, metric, and scalar invariance, as per a multi-group confirmatory factor analysis (MGCFA) approach [19, 20].

Furthermore, modification indices were examined for the most robust CFA model at each level where MGCFA results indicated non-invariance. Where necessary, model constraints were adjusted based on these indices. Items were either deleted or allowed to correlate, both within and across domains [32]. The raw item scores and aggregated domain scores were utilized at each level of analysis to ensure model accuracy.

If the data failed to meet the normality criteria, appropriate adjustments were applied in the CFA to account for the non-normality. Specifically, the Satorra-Bentler Chi-Square Correction was applied, accompanied by robust standard errors for evaluating individual parameters in the model. These modifications were carried out using the MLM estimator provided by the "lavaan" package in R [33, 34].

2.3 Hypothesized models for internal structure testing

Five different models were tested to determine which model provided the best fit. Two models were originally proposed by the MPOC tool developers, while three additional models were hypothesized based on the premise that all items ultimately measure a single overarching construct: family-centred care (FCC). These models were evaluated at both the overall sample level and within the private sector groups. Figures 1 to 5 depict the five models; their definitions and descriptions are as follows:

1. The Unidimensional model:

This model hypothesizes that all 24 items load onto a single factor, family-centred care (FCC). This hypothesis assumes that all MPOC-SP(A) items assess different aspects of FCC. If this model demonstrates a good fit, it suggests that a single factor adequately explains all items, forming a unified, meaningful construct.

2. The Four-factor model:

The second model, originally proposed by the tool developers, hypothesizes a four-factor structure in which each item loads onto one of four distinct factors:

- Showing Interpersonal Sensitivity (8 items);
- Providing General Information (4 items);
- Communicating Specific Information (3 items);
- Treating People Respectfully (9 items).

This model aligns with the theoretical foundation of the MPOC-SP(A) tool, which differentiates between these four key domains of FCC [7].

3. The Five-Factor Model:

The third model tested a five-factor structure, as suggested by the developers of the original MPOC tool. This structure extends the categorization of FCC-related dimensions, distinguishing an additional factor beyond the four-factor model [5].

4. The Second-Order factor model (four-factor):

This model hypothesizes that all items first load onto the four-factor model, which then loads onto a single overarching factor—FCC. This structure suggests that the four dimensions are interrelated and contribute collectively to a higher-order construct.

5. The Second-Order factor model (five-factor):

Like the four-factor second-order model, this model assumes that all items first load onto a five-factor structure, which then loads onto a single overarching FCC factor. This model assesses whether an additional dimension improves the overall explanatory power of the instrument.

2.4 Reliability

2.4.1 Internal consistency

Internal consistency was assessed using Cronbach's alpha (α), which was calculated in RStudio for the model that demonstrated the best fit. The corresponding R code can be found in the **Supplementary material**. The levels of internal consistency are presented in Table 1 [35].

TABLE 1. Levels of internal consistency according to Cronbach's Alpha.

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.8 \leq \alpha < 0.9$	Good
$0.7 \leq \alpha < 0.8$	Acceptable
$0.6 \leq \alpha < 0.7$	Questionable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

2.4.2 Interrater reliability (intraclass correlation coefficient—ICC)

ICC estimates and their 95% confidence intervals were calculated in R studio based on a mean-rating (k = 2), absolute-agreement, 2-way mixed-effects model.

• The ICC value represents the degree of reliability or agreement between raters or repeated measurements.

• The 95% confidence interval quantifies the range within which the true ICC value is likely to fall with 95% certainty.

• A narrower confidence interval suggests a more precise reliability estimate.

The ICC was calculated based on the mean of ratings for 47 participants who completed the questionnaire on two different occasions. This approach improves reliability by averaging multiple measurements rather than relying on a single administration.

The calculation considers absolute agreement, meaning that it accounts for both:

1. Relative agreement (consistency in ranking across measurements).

2. Exact value agreement, ensuring that measurements are not only consistently ranked but also closely aligned in absolute terms.

The two-way mixed-effects model assumes that:

• Subjects (or items) are treated as random effects, representing variability in responses.

Raters are treated as fixed effects, meaning they were specific to this study and not generalized to a larger population [36].

The R code for these calculations is available in the **Supplementary material**. The reliability thresholds for ICC are summarized in Table 2 [36].

TABLE 2. ICC's levels of reliability.

Intraclass Correlation Coefficient	Level of reliability
<0.5	Poor reliability
0.5 to 0.75	Moderate reliability
0.75 to 0.9	Good reliability
>0.9	Excellent reliability

3. Results

3.1 Demographics

134 healthcare providers participated in the study, comprising 89 (66.4%) from the public sector and 45 (33.6%) from the private sector. The demographic characteristics of the participants are outlined in Table 3.

3.2 Factor structure

3.2.1 Normality testing

Initial analyses of distributional properties revealed mixed results for multivariate normality. While Mardia's Kurtosis test supported multivariate normality, both Mardia's Skewness and Henze-Zirkler statistics indicated non-normal distribution. Univariate normality testing using Shapiro-Wilks and Anderson-Darling tests showed significant deviations from normality for all items (Tables 4 and 5). Given these findings, subsequent analyses employed robust estimation methods.

3.2.2 Confirmatory factor analysis

Eight alternative models were tested to determine the optimal factor structure of the MPOC-SP(A). The Satorra-Bentler scaled chi-square statistic was applied to account for non-normality in the data. Table 6 (Ref. [21–23]) presents the fit indices for all tested models.

The unidimensional model (Model 1) demonstrated poor fit with the following indices:

• CFI = 0.724,

• TLI = 0.697,

• RMSEA = 0.130,

• SRMR = 0.100.

Subsequent testing of multi-factor models showed progressive improvement in model fit:

• Model 2 (Four-factor): Showed improved, yet still inadequate fit, with indices:

○ CFI = 0.859,

○ TLI = 0.842,

○ RMSEA = 0.094,

○ SRMR = 0.080.

TABLE 3. Distribution of healthcare professional in the study.

Level	Allied Health Professional	Doctor	Nurse	*p* value
n	16	68	50	
Place of Practice				
Private	5 (31.2)	24 (35.3)	16 (32.0)	0.912
Public	11 (68.8)	44 (64.7)	34 (68.0)	
Years of clinical experience				
0–5	2 (12.5)	15 (22.1)	4 (8.0)	
6–10	4 (25.0)	18 (26.5)	13 (26.0)	
11–15	4 (25.0)	16 (23.5)	6 (12.0)	0.018
16–20	5 (31.2)	6 (8.8)	7 (14.0)	
More than 20	1 (6.2)	13 (19.1)	20 (40.0)	
Years of ICU experience				
0–5	4 (25.0)	42 (61.8)	11 (22.0)	
6–10	5 (31.2)	14 (20.6)	14 (28.0)	
11–15	5 (31.2)	5 (7.4)	6 (12.0)	<0.001
16–20	2 (12.5)	3 (4.4)	4 (8.0)	
More than 20	0 (0.0)	4 (5.9)	15 (30.0)	

ICU: intensive care unit.

TABLE 4. Univariate normality testing of the MPOC-SP(A) tool across groups.

Group	Sub-Test	Shapiro-Wilk Test		Anderson-Darling Test		Final Remarks and Conclusion
		W stat.	Shows Normality	W stat.	Shows Normality	
Public (n = 89)						
	sis1	0.898	No	2.808	No	
	sis11	0.928	No	1.810	No	
	sis2	0.859	No	4.382	No	
	sis3	0.847	No	3.744	No	
	sis4	0.907	No	2.838	No	
	sis5	0.916	No	2.754	No	
	sis8	0.904	No	2.775	No	
	sis9	0.927	No	1.952	No	
	csi13	0.858	No	4.413	No	
	csi14	0.906	No	2.447	No	
	csi15	0.860	No	3.748	No	
	tpr10	0.882	No	3.257	No	Univariate analysis shows non-normality, all measures considered
	tpr12	0.775	No	5.662	No	
	tpr16	0.905	No	2.393	No	
	tpr17	0.878	No	3.357	No	
	tpr18	0.898	No	2.825	No	
	tpr19	0.904	No	2.807	No	
	tpr20	0.808	No	5.296	No	
	tpr6	0.749	No	6.705	No	
	tpr7	0.938	No	1.758	No	
	pgi21	0.907	No	2.812	No	
	pgi22	0.909	No	2.584	No	
	pgi23	0.913	No	2.476	No	
	pgi24	0.923	No	2.033	No	

TABLE 4. Continued.

Group	Sub-Test	Shapiro-Wilk Test		Anderson-Darling Test		Final Remarks and Conclusion
		W stat.	Shows Normality	W stat.	Shows Normality	
Private (n = 45)						
	sis1	0.912	No	1.081	No	
	sis11	0.936	No	2.246	No	
	sis2	0.862	No	3.331	No	
	sis3	0.776	No	2.887	No	
	sis4	0.848	No	1.337	No	
	sis5	0.913	No	1.718	No	
	sis8	0.901	No	2.299	No	
	sis9	0.897	No	1.652	No	
	csi13	0.850	No	1.752	No	
	csi14	0.914	No	1.957	No	
	csi15	0.864	No	2.469	No	
	tpr10	0.861	No	1.519	No	Univariate analysis shows non-normality, all measures considered
	tpr12	0.831	No	1.098	No	
	tpr16	0.901	No	1.176	No	
	tpr17	0.931	No	1.098	No	
	tpr18	0.917	No	1.176	No	
	tpr19	0.896	No	1.582	No	
	tpr20	0.833	No	2.616	No	
	tpr6	0.760	No	3.571	No	
	tpr7	0.894	No	1.870	No	
	pgi21	0.930	No	1.130	No	
	pgi22	0.929	No	1.003	No	
	pgi23	0.913	No	1.225	No	
	pgi24	0.907	No	1.799	No	

p-value significant at < 0.05.

TABLE 5. Multivariate normality testing of MPOC-SP(A) tool across groups.

Group	Mardia Test				Henz-Zirkler Test		Conclusion
	Mardia Skewness		Mardia Kurtosis		Henz-Zirkler statistic		
	Statistic	Consistent with MVN	Statistic	Consistent with MVN	HZ stat.	Consistent with MVN	
Public N = 89	4376.972	No	14.321	No	1.024	No	MVN is non-normal
Private N = 45	2805.901	No	0.527	Yes	1.000	No	MVN is non-normal

p-value significant at < 0.05. MVN: Multivariate Normality; HZ stat.: Henz-Zirkler Statistics.

TABLE 6. Confirmatory factor analysis of plausible models.

Group	Fit indices	Model 1: Unidimen model	Model 2: Four-factor model	Model 3: Five-factor model	Model 4: 2nd order (four-factor)	Model 5: 2nd order (five-factor)	Model 8: Four factor model, reduced constrains, items deleted	Cited benchmark
MPOC-SP(A) tool								
	Satorra-Bentler Chi Square (*df*)	662.250* (252)	449.428* (246)	494.625* (242)	452.533* (248)	507.429* (247)	**181.278 (111)**	The smaller the better
	AIC	11,573.548	11,305.504	11,375.713	11,302.466	11,378.56	**7917.016**	The smaller the better
	BIC[3]	11,560.809	11,291.173	11,360.32	11,288.665	11,364.493	**7905.869**	The smaller the better
	CFI[4]	0.724	0.859	0.826	0.859	0.822	**0.933**	>**0.90**[1]
	TLI[4]	0.697	0.842	0.801	0.843	0.801	**0.918**	>**0.90**[1]
	RMSEA	0.130	0.094	0.106	0.094	0.106	**0.079**	<**0.08**[2]
	SRMR	0.100	0.080	0.084	0.081	0.087	**0.072**	<**0.08**[2]
Public (n = 89)								
	Satorra-Bentler Chi Square (*df*)	544.212* (252)	403.058* (246)	438.331* (242)	405.744* (248)	445.781* (247)	**172.662 (111)**	The smaller the better
	AIC	7782.012	7600.77	7659.724	7597.66	7658.469	**5284.199**	The smaller the better
	BIC[3]	7749.987	7564.741	7621.027	7562.996	7623.108	**5256.176**	The smaller the better
	CFI[4]	0.733	0.854	0.817	0.854	0.816	**0.923**	>0.90[1]
	TLI[4]	0.708	0.836	0.792	0.837	0.794	**0.906**	>0.90[1]
	RMSEA[4]	0.114	0.103	0.116	0.103	0.116	0.092	<0.08[2]
	SRMR	0.102	0.085	0.090	0.085	0.092	**0.078**	<0.08[2]
Private (n = 45)								
	Satorra-Bentler Chi Square (*df*)	528.305* (252)	419.310* (246)	430.388* (242)	422.078* (248)	448.422* (247)	**207.830 (111)**	The smaller the better
	AIC	3803.854	3700.882	3701.579	3697.767	3711.328	**2630.885**	The smaller the better
	BIC[3]	3740.114	3629.175	3624.56	3628.716	3640.949	**2575.113**	The smaller the better
	CFI[4]	0.467	0.657	0.643	0.658	0.618	0.707	>0.90[1]
	TLI[4]	0.416	0.616	0.592	0.619	0.574	0.642	>0.90[1]
	RMSEA[4]	0.168	0.137	0.141	0.136	0.144	0.147	<0.08[2]
	SRMR	0.153	0.137	0.140	0.136	0.143	0.113	<0.08[2]

**p-value significant at* < 0.001; [1]*A value of 0.90 served as the rule-of-thumb cut point of acceptable fit [21];* [2]*An RMSEA less than 0.08 considered an acceptable fit [22];* [3]*Sample size adjusted BIC (SABIC);* [4]*Robust CFI, Robust TLI and RMSEA [23]. MPOC-SP(A): Measures of Process of Care for Service Providers; df: degree of freedom; CFI: Comparative fit index; TLI: Tucker-Lewis index; RMSEA: Root mean square error of approximation; SRMR: Standardized Root Mean Square Residual; AIC: Akaike Information Criterion; BIC: Bayesian Information Criterion.*

The bolded numbers show that these were the best results according to the cited benchmark (next column).

• Models 3–5: Demonstrated similar fit indices with minimal improvements, suggesting that further modification were necessary.

• Model 8 (Modified four-factor with 17 items): Demonstrated the best fit, with the following indices:

○ CFI = 0.933,

○ TLI = 0.918,

○ RMSEA = 0.079,

○ SRMR = 0.072.

3.2.3 Sector-specific model fit

The model fit indices varied between public and private sectors:

• Public Sector (n = 89):

○ CFI = 0.923,

○ TLI = 0.906,

○ RMSEA = 0.092,

○ SRMR = 0.078.

• Private Sector (n = 45):

○ CFI = 0.707,

○ TLI = 0.642,

○ RMSEA = 0.147,

○ SRMR = 0.113.

3.3 Reliability testing

3.3.1 Internal consistency

Cronbach's alpha coefficients demonstrated strong internal consistency of the MPOC-SP(A) and its subscales. The results indicate strong internal reliability:

• Overall MPOC-SP(A): $\alpha = 0.928$;

• Showing Interpersonal Sensitivity: $\alpha = 0.858$;

• Providing General Information: $\alpha = 0.879$;

• Communicating Specific Information: $\alpha = 0.691$ (borderline acceptable);

• Treating People Respectfully: $\alpha = 0.898$.

3.3.2 Test-retest reliability (ICC(A,1))

Intraclass Correlation Coefficients (ICC) were calculated using a two-way agreement model to assess the temporal stability of the MPOC-SP(A) across two measurement occasions:

• Overall Scale: ICC(A,1) = 0.416 (95% confidence interval (CI): 0.155–0.625) (moderate reliability)

• Domain-specific ICCs:

○ Showing Interpersonal Sensitivity: 0.543;

○ Providing General Information: 0.582;

○ Communicating Specific Information: 0.534;

○ Treating People Respectfully: 0.525.

The test-retest analysis was conducted with 47 participants, who completed the measure on two occasions. The F-test for ICC significance demonstrated a statistically significant result:

• $F(46,47) = 2.46$, $p = 0.001$, indicating significant temporal stability despite moderate ICC values.

4. Discussion

This study aimed to validate the factor structure and psychometric properties of the MPOC-SP(A) tool in South Africa. The findings provide substantial evidence for the reliability and validity of a modified four-factor structure, while also highlighting areas requiring further investigation.

4.1 Normality assessment

The assessment of multivariate normality using Mardia's tests yielded mixed results. While Mardia's Kurtosis indicated multivariate normality, Mardia's Skewness and the Henze-Zirkler statistic suggested deviations from multivariate normality. Additionally, univariate normality tests using Shapiro-Wilks and Anderson-Darling tests revealed non-normality for each item.

These findings suggest that the data do not adhere to the assumptions of normality, which is a common prerequisite for CFA [26, 27]. The lack of normality may impact the reliability of the CFA results, particularly the chi-square statistic, which is sensitive to deviations from normality. Due to deviations from normality, CFA was conducted using robust estimation methods.

4.2 Factor structure and model fit

The confirmatory factor analysis supported a four-factor model with reduced constraints and item modifications (Model 8) as the best-fitting solution. This model demonstrated good fit indices meeting established benchmarks for acceptable model fit:

• CFI = 0.933,

• TLI = 0.918,

• RMSEA = 0.079,

• SRMR = 0.072.

When compared to similar validation studies, our findings align with a study conducted in the United Arab Emirates, where the four-factor structure of the 27-item MPOC-SP tool initially showed a poor model fit (Chi-square = 4.92 (minimum chi-square (CMIN)= 2638.66/df = 536), CFI = 0.77, TLI = 0.71, RMSEA = 0.14 and SRMR = 0.06). However, after deleting items and including covariance errors, the resulting 19-item MPOC-SP tool showed an improved fit (Chi-square = 2.62 (CMIN = 375.15/df = 143), CFI = 0.92, TLI = 0.90, RMSEA = 0.10, and SRMR = 0.06) [12].

Other validation studies did not conduct confirmatory factor analysis but instead relied on Pearson's and Spearman's correlation coefficient, which have more recently been deemed inappropriate tests for determining the factor structure [7, 8, 10, 11]. The improved fit indices of our model suggest that the modifications made to the MPOC-SP(A) have enhanced its structural validity in the South African context.

The four-factor structure aligns with the theorised framework of the original MPOC-SP(A) tool [7, 8]. However, the model fit varied between the public and private sectors, with the model fit being notably better in the public sector compared to the private sector, a finding that appears counterintuitive given the resource constraints and systemic challenges typically associated with public healthcare settings. This inconsistency suggests that the observed differences may not solely reflect genuine variation in FCC perceptions or practice but could be influenced by unequal sample sizes between the two groups, potentially affecting the sensitivity and stability of the model fit indices. The larger sample size from the public sector likely increased the statistical power of the analysis, thereby facilitating more stable parameter estimation and enhancing overall model performance. These findings highlight the need for sector-specific strategies to support FCC implementation and underscore the importance of contextualising psychometric assessments within diverse healthcare settings.

4.3 Internal consistency and reliability

The MPOC-SP(A) demonstrated strong internal consistency, with an overall Cronbach's alpha of 0.93. Three of the four domains showed robust reliability (α = 0.86–0.90), while the Communicating Specific Information domain showed moderate reliability (α = 0.69).

Cronbach's values ranging between 0.70 and 0.90, typically indicate good consistency, suggesting that items within each domain measure the same construct. However, higher alpha values may imply redundancy, where some items overlap in measuring similar aspects [15].

The pattern of consistency observed in our study aligns with findings from the original validation study on the MPOC-SP(A) tool, which reported alpha values between 0.67 to 0.88 [8]. The lower internal consistency in the Communicating Specific Information domain may be attributed to the small number of items in this domain [8].

Test-retest reliability analysis resulted in an overall ICC(A,1) of 0.416, with a 95% confidence interval of 0.155 to 0.625, indicating poor to moderate reliability. However, the domain-specific ICCs ranged from 0.520 to 0.582, suggesting moderate reliability across the different domains. The F-test demonstrated:

- $F(46,47)$ = 2.46, p = 0.001, confirming statistical significance and temporal stability, despite moderate agreement levels.

These moderate ICC suggest acceptable test-retest reliability, particularly given the complex and dynamic nature of ICU settings. In contexts where perceptions of care may be influenced by daily variability in workflow, communication, and patient interactions, moderate agreement reflects both the tool's stability and the natural fluctuation in responses. These values highlight the tool's utility while also indicating potential areas for refinement or adaptation to specific clinical environments.

Despite these limitations, the statistically significant F-test results support the tool's potential utility in assessing FCC practices in adult ICUs. Other validation studies have reported ICC values ranging from 0.22 to 0.95 [7, 9, 10, 37].

It is essential to highlight that while many studies have tested test-retest reliability using ICC, only two explicitly specified the type of ICC employed.

- Kim *et al*. [37] utilised a two-way mixed-effects model with absolute agreement (ICC(A,1)), which is the same method employed in our study. Their study reported ICC values ranging from 0.22 to 0.78 (n = 20), indicating poor to good reliability [37]. In contrast, our study found that each domain exhibited moderate reliability.
- Himuro *et al*. [9] used ICC(2,1), reporting ICC values ranging from 0.68 to 0.95 (n = 20). However, this study assumed that raters were randomly selected, making their results generalizable to a broader population [9].

The remaining two studies did not specify which ICC model was used, but both reported high ICC values:

- Woodside *et al*. [7]: ICC 0.79 to 0.99 (n = 29);
- Siebes *et al*. [10]: ICC 0.83 to 0.89 (n = 13).

4.4 Sample size considerations in ICC calculations

One important factor to consider in the four studies is their sample size, which was relatively smaller than that used in our study. According to Bujang and Baharum, the Intraclass Correlation Coefficient (ICC) can be estimated based on the sample size. They argue that when observations of a subject are conducted on two occasions, as in these studies, the minimum sample size required to achieve ICC values of:

- 0.7 is 10,
- 0.8 is 7,
- 0.9 is 5 [38].

This suggests that smaller sample sizes increase the likelihood of observing moderate to excellent reliability.

Although our ICC values are lower than preferred, this may be influenced by the sample size, as well as the dynamic nature of healthcare service delivery rather than any instability in the measurement instrument. The behaviours and approaches of providers can vary significantly across different patient interactions and clinical contexts, which may contribute to the variability observed over time.

4.5 Implications for practice

The validation of the MPOC-SP(A) provides healthcare organizations with a psychometrically robust instrument for assessing the quality-of-service delivery. The strong internal consistency suggests the tool reliably captures distinct aspects of service provision, while the moderate test-retest reliability indicates sensitivity to temporal variations in service delivery patterns.

The differential performance across public and private sectors underscores the need for sector-specific considerations in implementation and interpretation. These findings suggest that healthcare organizations should tailor their approaches based on the unique structural and operational differences within public and private ICU settings.

4.6 Limitations and future directions

A limitation of this study is the unequal sample sizes between the public (n = 89) and private (n = 45) sectors. While both meet the minimum requirements for validation, the smaller private sector sample may limit generalizability. Nonetheless, including both sectors adds contextual relevance. Future research should aim for larger, more balanced samples to strengthen external validity.

5. Conclusions

The MPOC-SP(A) demonstrates strong psychometric properties, particularly in terms of internal consistency and factor structure. Although test-retest reliability is moderate, it remains acceptable for assessing complex and subjective constructs like Family-Centred Care (FCC).

Its statistical significance and rigorous validation process highlight its potential to provide insightful and actionable information. As such, the MPOC-SP(A) tool is well-suited for implementation in adult Intensive Care Units (ICUs) to assess healthcare providers' perception of FCC.

There are also opportunities for future refinement to further enhance its reliability and applicability across different clinical settings.

AVAILABILITY OF DATA AND MATERIALS

Data are not publicly available due to participant confidentiality but may be available from the corresponding author upon reasonable request and subject to ethics approval.

AUTHOR CONTRIBUTIONS

CONO and SC—designed the research study; performed the research. CONO—analysed the data; wrote the manuscript. SC—reviewed the manuscript. Both authors contributed to editorial changes in the manuscript. Both authors read and approved of the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from Stellenbosch University's Human Research Ethics Committee (HREC approval number: N24/07/089 Sub Study N24/03/032). Informed consent was digitally collected. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found, in the online version, at https://oss.signavitae.com/mre-signavitae/article/1986674827702747136/attachment/Supplementary%20material.docx.

REFERENCES

[1] Jordan P. Family-centred care in intensive care units. Southern African Journal of Critical Care. 2018; 34: 34–35.

[2] Kleinpell R, Heyland DK, Lipman J, Sprung CL, Levy M, Mer M, *et al*. Patient and family engagement in the ICU: report from the task force of the World Federation of Societies of Intensive and Critical Care Medicine. Journal of Critical Care. 2018; 48: 251–256.

[3] Wilson LL, Dunst CJ. Checklist for assessing adherence to family-centered practices. 2005. Available at: https://ncwwi.org/files/Vision_Mission_Values/Checklist_for_Assessing_Adherence_to_Family-Centered_Practices.pdf (Accessed 30 April 2024).

[4] Cunningham BJ, Rosenbaum PL. Measure of processes of care: a review of 20 years of research. Developmental Medicine & Child Neurology. 2014; 56: 445–452.

[5] King SM, Rosenbaum PL, King GA. Parents' perceptions of caregiving: development and validation of a measure of processes. Developmental Medicine & Child Neurology. 1996; 38: 757–772.

[6] King GA, Rosenbaum PL, King SM. Evaluating family-centred service using a measure of parents' perceptions. Child: Care, Health and Development. 1997; 23: 47–62.

[7] Woodside JM, Rosenbaum PL, King SM, King GA. Family-centered service: developing and validating a self-assessment tool for pediatric service providers. Children's Health Care. 2001; 30: 237–252.

[8] Bamm EL, Rosenbaum P, Wilkins S, Stratford P. Performance of the measures of processes of care for adults and service providers in rehabilitation settings. Patient Related Outcome Measures. 2015; 6: 157–165.

[9] Himuro N, Miyagishima S, Kozuka N, Tsutsumi H, Mori M. Measurement of family-centered care in the neonatal intensive care unit and professional background. Journal of Perinatology. 2015; 35: 284–289.

[10] Siebes RC, Ketelaar M, Wijnroks L, van Schie PEM, Nijhuis BJG, Vermeer A, *et al*. Family-centred services in The Netherlands: validating a self-report measure for paediatric service providers. Clinical Rehabilitation. 2006; 20: 502–512.

[11] Siebes RC, Nijhuis BJG, Boonstra AM, Ketelaar M, Wijnroks L, Reinders-Messelink HA, *et al*. A family-specific use of the measure of processes of care for service providers (MPOC-SP). Clinical Rehabilitation. 2008; 22: 242–251.

[12] Opoku MP, Pearson E, Elhoweris H, Alhosani N, Mustafa A, Efstratopoulou M, *et al*. Fidelity of family centered care model to early disability diagnosis and rehabilitation in the United Arab Emirates. PLOS ONE. 2024; 19: e0301094.

[13] Oghenetega C, Chetty S. Validating the Measure of processes of care for service providers (MPOC-SP(A)) tool in adult intensive care units. Southern African Journal of Critical Care. 2025; 41: e2662.

[14] Prinsen CAC, Mokkink LB, Bouter LM, Alonso J, Patrick DL, de Vet HCW, *et al*. COSMIN guideline for systematic reviews of patient-reported outcome measures. Quality of Life Research. 2018; 27:1147–1157.

[15] Tavakol M, Dennick R. Making sense of Cronbach's alpha. International Journal of Medical Education. 2011; 2: 53–55.

[16] Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, *et al*. The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes. Journal of Clinical Epidemiology. 2010; 63: 737–745.

[17] Lavrakas PJ. Encyclopedia of survey research methods. Sage Publications, Inc.: Thousand Oaks, CA, USA. 2008.

[18] Ballangrud R, Husebø SE, Hall-Lord ML. Cross-cultural validation and psychometric testing of the Norwegian version of the TeamSTEPPS® teamwork perceptions questionnaire. BMC Health Services Research. 2017; 17: 799.

[19] Chen FF, Sousa KH, West SG. Teacher's corner: testing measurement invariance of second-order factor models. Structural Equation Modeling. 2005; 12: 471–492.

[20] Fischer R, Karl JA. A primer to (cross-cultural) multi-group invariance testing possibilities in R. Frontiers in Psychology. 2019; 10: 1507.
[21] Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Structural Equation Modeling. 1999; 6: 1–55.
[22] McDonald RP, Ho M-HR. Principles and practice in reporting structural equation analyses. Psychological Methods. 2002; 7: 64–82.
[23] Savalei V. On the computation of the RMSEA and CFI from the mean-and-variance corrected test statistic with nonnormal data in SEM. Multivariate Behavioral Research. 2018; 53: 419–429.
[24] Shapiro SS, Wilk MB. An analysis of variance test for normality (complete samples). Biometrika. 1965; 52: 591–611.
[25] Anderson TW, Darling DA. A test of goodness of fit. Journal of the American Statistical Association. 1954; 49: 765–769.
[26] Mardia KV. 9 Tests of unvariate and multivariate normality. In Krishnaiah PR, Rao DB (eds.) Handbook of statistics (pp. 279–320). Elsevier: Amsterdam. 1980.
[27] Henze N, Zirkler B. A class of invariant consistent tests for multivariate normality. Communications in Statistics—Theory and Methods. 1990; 19: 3595–3617.
[28] Wilk MB, Gnanadesikan R. Probability plotting methods for the analysis of data. Biometrika. 1968; 55: 1–17.
[29] Korkmaz S, Goksuluk D, Zararsiz G. MVN: an R package for assessing multivariate normality. The R Journal. 2014; 6: 151–162.
[30] Ghasemi A, Zahediasl S. Normality tests for statistical analysis: a guide for non-statisticians. International Journal of Endocrinology and Metabolism. 2012; 10: 486–489.
[31] Kim H-Y. Statistical notes for clinical researchers: assessing normal distribution (2) using skewness and kurtosis. Restorative Dentistry & Endodontics. 2013; 38: 52–54.
[32] Awang Z. A handbook on structural equation modeling. MPWS Rich Resources: Malaysia. 2014.
[33] Satorra A, Fabra UP. A scaled difference chi-square test statistic for moment structure analysis 1988. Available at: https://escholarship.org/uc/item/3141h70c (Accessed: 01 January 2025).
[34] Rosseel Y. lavaan: an R package for structural equation modeling. Journal of Statistical Software. 2012; 48: 1–36.
[35] Cronbach LJ. Coefficient alpha and the internal structure of tests. Psychometrika. 1951; 16: 297–334.
[36] Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. Journal of Chiropractic Medicine. 2016; 15: 155–163.
[37] Kim J, An M, Kim J. Measurement of family-centered services: validation of the Korean translation of the measure of processes of care for service providers. Journal of Pediatric Rehabilitation Medicine. 2022; 15: 499–505.
[38] Bujang MA. A simplified guide to determination of sample size requirements for estimating the value of intraclass correlation coefficient: a review. Archives of Orofacial Sciences. 2017; 12: 1–11.

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