Vol. 2, No.2 September 2026
HEART: Health, Extended & Applied Research
https://openjournal.dinamikapublika.id/index.php/HEART

Telemedicine Utilization and Patient Satisfaction: The Mediating Role of Perceived Service Quality and Moderating Effect of Technology Acceptance in Primary Healthcare Settings

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ABSTRACT

Telemedicine has become a routine entry point to primary care, yet its relationship with patient satisfaction remains unclear. Drawing on the information systems success, expectation–confirmation, and technology acceptance models, this study examines the mediating role of perceived service quality and the moderating role of technology acceptance in the relationship between telemedicine utilization and patient satisfaction. A cross-sectional survey of 427 teleconsultation users at community health centres (Puskesmas) and private primary clinics across five Indonesian provinces was analysed using partial least squares structural equation modelling, with a two-stage interaction approach and 5,000 bootstrap resamples. Utilization positively influenced perceived service quality ($\beta = 0.439$) and satisfaction ($\beta = 0.239$), while perceived service quality was the strongest predictor of satisfaction ($\beta = 0.513$). Service quality mediated 48.5% of the total effect, indicating complementary partial mediation. Technology acceptance strengthened the utilization–quality relationship ($\beta = 0.159$), but did not moderate the direct relationship with satisfaction ($\beta = -0.003$, n.s.). The indirect effect increased from 0.144 at low acceptance to 0.307 at high acceptance. The utilization–quality relationship was weaker in Puskesmas than in private clinics. The model explained 55.2% of satisfaction variance. These findings highlight the importance of service reliability and patient onboarding alongside teleconsultation expansion.

Keywords: ***Digital health; Teleconsultation; PLS-SEM; Moderated mediation; Indonesia***

1. INTRODUCTION

Primary care is where telemedicine can become an integral part of routine healthcare rather than remain an emergency measure. During the COVID-19 pandemic, teleconsultation helped maintain essential health services across South-East Asia, although much of its use focused on immediate crisis management rather than chronic and preventive care (Gudi et al., 2021). The World Health Organization (2022) subsequently emphasised integrating telemedicine into routine service delivery. In Indonesia, Mobile JKN introduced doctor consultations in 2020, connecting insured patients with physicians at their registered primary care facilities. By October 2021, 10.4 million teleconsultation services had been reported at first-level facilities (Syahputra, 2021). This

development was supported by the Ministry of Health's digital transformation blueprint (Kementerian Kesehatan Republik Indonesia, 2021), the 2023 Health Law, and its implementing regulation (Undang-Undang Nomor 17 Tahun 2023; Peraturan Pemerintah Nomor 28 Tahun 2024).

However, expanding telemedicine access does not necessarily guarantee patient satisfaction. Indonesia's primary care system includes more than ten thousand Puskesmas alongside private clinics and general practices with varying staffing and digital capacities (Kementerian Kesehatan Republik Indonesia, 2024). Although internet penetration reached 79.5% in 2024, rural access remained lower than urban access (Asosiasi Penyelenggara Jasa Internet Indonesia, 2024). Consequently, frequent telemedicine utilization may reflect either positive experiences or repeated attempts to resolve unmet healthcare needs (Aboalganam et al., 2024).

Three research streams provide the theoretical foundation for understanding this relationship. First, telemedicine satisfaction research generally reports positive patient experiences associated with convenience, communication, lower costs, and reduced travel (Kruse et al., 2017; Orlando et al., 2019). Video consultations have also demonstrated higher satisfaction than in-person visits in some settings (Ramaswamy et al., 2020), although acceptance varies across demographic groups (Bashshur et al., 2016). However, these studies primarily examine satisfaction levels or differences between consultation modalities rather than variations in utilization intensity (Muslim, 2020).

Second, service quality literature explains satisfaction through reliability, responsiveness, assurance, and empathy (Donabedian, 1988; Parasuraman et al., 1988). Digital healthcare research further demonstrates that multidimensional service quality predicts satisfaction and continuance intention (Akter et al., 2013). In Bangladesh, service quality was positively associated with teleconsultation satisfaction ($\beta = 0.327$) and intention to reuse the service (Khatun et al., 2024). Nevertheless, utilization is generally positioned as an outcome rather than an experience that shapes quality (Yi et al., 2024).

Third, technology acceptance research explains adoption through perceived usefulness, ease of use, and related beliefs (Davis, 1989; Venkatesh et al., 2003). These models dominate telemedicine acceptance research (Harst et al., 2019), although their application requires consideration of healthcare contexts (Holden & Karsh, 2010). Previous studies identify usefulness, ease of use, trust, and facilitating conditions as important acceptance factors (Baudier et al., 2021; Kamal et al., 2020). In Indonesia, facilitating conditions and social influence were not significant predictors of behavioural intention to use hospital teleconsultation applications (Alexandra et al., 2021). However, the role of technology acceptance after adoption remains insufficiently examined (Rolando, 2025b).

These research streams leave an important theoretical question unresolved. The information systems success model considers system quality, use, and satisfaction as interrelated constructs (DeLone & McLean, 2003), while expectation–confirmation theory explains how experiences influence satisfaction (Bhattacherjee, 2001). Repeated use may strengthen satisfaction when expectations are fulfilled but may also expose service shortcomings (Oliver, 1980). Evidence from Indonesian primary care similarly identifies connectivity problems despite generally positive

clinician satisfaction (Indria et al., 2020). Thus, the relationship between utilization and satisfaction may depend on perceived service quality and patients' technological readiness (Rolando et al., 2025).

Three research gaps emerge. First, perceived service quality has rarely been examined as a mediator between telemedicine utilization and satisfaction, particularly alongside technology acceptance as a moderator. Second, previous studies predominantly examine adoption intentions rather than the intensity and breadth of actual utilization. Third, evidence remains limited in publicly financed primary care systems in middle-income countries, particularly Indonesia, where digital infrastructure and organisational capacity vary across facilities (Srinivas et al., 2023).

Accordingly, this study examines four objectives: (1) the relationship between telemedicine utilization and patient satisfaction; (2) the mediating role of perceived service quality; (3) the moderating role of technology acceptance in the relationships between utilization, service quality, and satisfaction; and (4) the conditional indirect effect of utilization on satisfaction through perceived service quality. By integrating these relationships, the study contributes to understanding how telemedicine utilization translates into patient satisfaction and provides practical evidence from Puskesmas and private primary clinics across five Indonesian provinces.

1.1 Hypothesis Development

Utilization and satisfaction. The information systems success model and expectation–confirmation theory suggest that positive experiences with repeated service use strengthen user satisfaction (DeLone & McLean, 2003; Bhattacherjee, 2001). Teleconsultation also provides benefits such as reduced travel and easier communication (Kruse et al., 2017; Orlando et al., 2019).

H1: Telemedicine utilization is positively related to patient satisfaction.

Utilization and perceived service quality. Healthcare quality is assessed through the care process and patients' actual experiences (Donabedian, 1988). Repeated teleconsultation allows patients to evaluate service reliability, responsiveness, and communication, shaping their quality perceptions (Akter et al., 2013; Khatun et al., 2024).

H2: Telemedicine utilization is positively related to perceived service quality.

Perceived service quality and satisfaction. Service quality is an important determinant of satisfaction, including in digital healthcare services (Dagger et al., 2007; Parasuraman et al., 1988). Previous teleconsultation studies confirm this positive relationship (Amin et al., 2022; Khatun et al., 2024).

H3: Perceived service quality is positively related to patient satisfaction.

The mediating role of perceived service quality. Utilization may increase satisfaction through improved quality perceptions, consistent with the healthcare process–outcome relationship and expectation evaluation (Donabedian, 1988; Oliver, 1980). However, convenience benefits may also influence satisfaction directly (Rolando & Mulyono, 2025).

H4: Perceived service quality mediates the relationship between telemedicine utilization and patient satisfaction.

The moderating role of technology acceptance. Technology acceptance reflects perceived usefulness and ease of use (Davis, 1989; Venkatesh et al., 2003), which influence telemedicine adoption (Harst et al., 2019; Kamal et al., 2020). After adoption, acceptance may determine how

effectively patients translate utilization into positive quality perceptions and satisfaction. Age and education may also influence technology readiness (Scott Kruse et al., 2018; Baudier et al., 2021).
H5: Technology acceptance strengthens the positive relationship between telemedicine utilization and perceived service quality (Rolando & Mulyono, 2024).
H6: Technology acceptance strengthens the positive relationship between telemedicine utilization and patient satisfaction.

Conditional indirect effect. When technology acceptance strengthens the utilization–quality relationship, the indirect effect of utilization on satisfaction through perceived service quality is expected to increase (Hayes, 2015).
H7: The indirect effect of telemedicine utilization on patient satisfaction through perceived service quality is stronger at higher levels of technology acceptance.

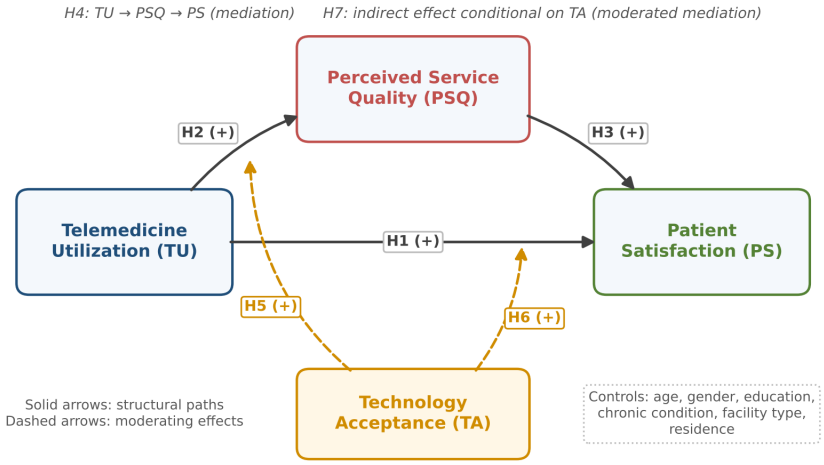

Figure 1. Conceptual Model and Hypotheses
Source: Authors' elaboration.

2. RESEARCH METHOD

2.1 Research Design

The study used a quantitative, explanatory, cross-sectional survey design with the individual patient as the unit of analysis. Constructs were measured with multi-item reflective scales, and the hypothesised relationships were estimated with partial least squares structural equation modelling (PLS-SEM). PLS-SEM was preferred to covariance-based estimation for three reasons: the model combines mediation with latent interaction terms, the research aim includes predicting an outcome that managers can influence, and the method makes no distributional assumptions about ordinal Likert data (Hair et al., 2019). Figure 1 summarises the research stages.

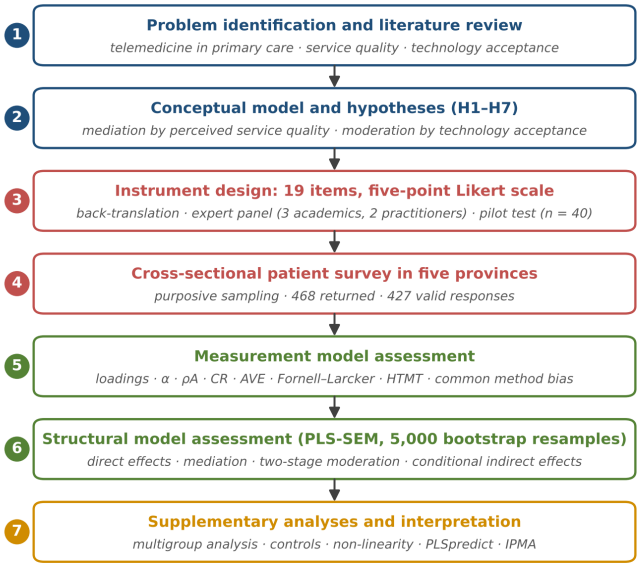

Figure 2. Research Stages
Source: Authors' elaboration

2.2 Population and Sample

The population comprised adult patients (18 years or older) registered at primary care facilities in Indonesia who had used a teleconsultation service provided by, or linked to, that facility. Because no sampling frame of telemedicine users exists at facility level, purposive sampling was applied with three inclusion criteria. The respondent (a) was registered at a Puskesmas or at a private primary clinic or general practice, (b) had completed at least one teleconsultation with a clinician of that facility in the preceding six months, and (c) had consulted on their own behalf rather than for a family member. Recruitment took place in five provinces chosen to vary in urbanisation and digital infrastructure: DKI Jakarta, West Java, East Java, Bali and South Sulawesi. Twenty-four facilities took part, 14 Puskesmas and 10 private clinics or practices, approached through district health offices and clinic associations.

Minimum sample size was determined with the inverse square root method (Kock & Hadaya, 2018). Assuming a minimum path coefficient of 0.15, a significance level of 5% and statistical power of 80%, the required sample is $(2.486/0.15)^2$, or 275 respondents. To allow for subgroup analysis and unusable responses, 480 questionnaires were targeted. In total 468 were returned, and 427 were retained after excluding 19 incomplete responses, 14 that failed an attention-check item and 8 with identical answers to every item. The final sample exceeds the minimum by more than half and is also adequate for the smallest significant coefficient subsequently observed. Each subgroup used in the multigroup analysis contained at least 173 respondents, which by the same method is sufficient to detect path coefficients of 0.20 or larger.

2.3 Data Collection

Data were collected with a self-administered questionnaire in Bahasa Indonesia. Facility staff offered eligible patients a link or QR code to an online form, the link was also shared through facility messaging groups, and a paper version was available on request. The opening page explained the purpose of the study, the voluntary and anonymous nature of participation and the right to withdraw at any point, and respondents gave informed consent before proceeding. No names, insurance numbers or clinical records were collected. Questionnaires with a missing response on any model item were treated as incomplete and excluded, so the analysis sample contains no missing values. Predictor and outcome items were placed in separate sections of the questionnaire, with demographic and usage questions between them.

2.4 Measures

All constructs were measured with items adapted from established scales and rated on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Telemedicine utilization was measured with four items capturing the regularity, breadth and routinisation of use, adapted from the use dimension of the information systems success model (DeLone & McLean, 2003) and from use-behaviour measures in the acceptance literature (Venkatesh et al., 2003). Perceived service quality was measured with six items covering reliability, responsiveness, assurance, empathy, information quality and privacy, adapted from SERVQUAL (Parasuraman et al., 1988) and from the mobile-health service quality instrument of Akter et al. (2013). Technology acceptance was measured with five items reflecting perceived usefulness, perceived ease of use and comfort with digital health tools (Davis, 1989; Venkatesh et al., 2003). Patient satisfaction was measured with four items on overall satisfaction, fulfilment of expectations and the acceptability of telemedicine as a mode of care, adapted from Oliver (1980) and from the satisfaction subscale of the Telehealth Usability Questionnaire (Parmanto et al., 2016). A single categorical question on the number of teleconsultations in the preceding six months was also included, both to describe the sample and to check the utilization scale against reported frequency. Items were translated into Bahasa Indonesia and back-translated by two bilingual translators working independently. Table 1 lists the constructs, item wording and sources. Age, gender, education, presence of a chronic condition, facility type and place of residence were recorded as control variables.

Table 1. Constructs, Measurement Items and Sources

Construct	Code	Item	Adapted from
Telemedicine utilization	TU1	I use the teleconsultation service of my primary care facility regularly when I need a consultation.	DeLone & McLean (2003); Venkatesh et al. (2003)
	TU2	I use teleconsultation for a range of needs (new complaints, follow-up, prescription renewal, health monitoring).	
	TU3	Over the past six months, teleconsultation has become a routine part of how I obtain primary care.	

Construct	Code	Item	Adapted from
	TU4	I turn to teleconsultation first before deciding whether to visit the facility in person.	
Perceived service quality	PSQ1	The teleconsultation service is delivered as promised and without interruption (reliability).	Parasuraman et al. (1988); Akter et al. (2013)
	PSQ2	The doctor or health worker responds to me promptly (responsiveness).	
	PSQ3	I am confident in the competence of the clinician who attends to me remotely (assurance).	
	PSQ4	The clinician gives me individual attention and understands my concerns (empathy).	
	PSQ5	The information and advice I receive are clear and sufficient (information quality).	
	PSQ6	I feel that my personal health information is handled safely (privacy).	
Technology acceptance	TA1	Using teleconsultation makes it easier for me to obtain care.	Davis (1989); Venkatesh et al. (2003)
	TA2	Teleconsultation is useful for managing my health.	
	TA3	Learning to operate the teleconsultation application was easy for me.	
	TA4	I find the teleconsultation application clear and understandable to use.	
	TA5	I am comfortable using digital technology for health purposes.	
Patient satisfaction	PS1	Overall, I am satisfied with the teleconsultation service.	Oliver (1980); Parmanto et al. (2016)
	PS2	The teleconsultation service met my expectations.	
	PS3	Teleconsultation is an acceptable way for me to receive primary care.	
	PS4	My experience of consulting remotely has been a pleasant one.	

Source: Authors' compilation from the cited instruments.

2.5 Data Analysis

Analysis followed the two-step procedure recommended for PLS-SEM (Hair et al., 2019, 2022). The measurement model was assessed through indicator loadings (threshold 0.708), Cronbach's alpha, ρA and composite reliability (0.70 to 0.95) and average variance extracted (AVE;

at least 0.50). Discriminant validity was assessed with the Fornell–Larcker criterion (Fornell & Larcker, 1981) and the heterotrait–monotrait ratio of correlations (HTMT; below 0.85) with bootstrap confidence intervals (Henseler et al., 2015). The structural model was estimated with the path weighting scheme, and significance was assessed with 5,000 bootstrap resamples and two-tailed tests. Collinearity (VIF), explained variance (R^2), effect sizes (f^2) and the standardised root mean square residual (SRMR) were examined.

Moderation was modelled with the two-stage approach, in which latent variable scores from the main-effects model are used to form the product term (Hair et al., 2022). Mediation was classified following Zhao et al. (2010). The conditional indirect effect was tested with the index of moderated mediation (Hayes, 2015), with indirect effects evaluated one standard deviation below the mean, at the mean and one standard deviation above the mean of technology acceptance. Out-of-sample predictive power was examined with PLSpredict using ten folds (Shmueli et al., 2019) (Jonathan et al., 2025). Supplementary analyses comprised permutation-based multigroup analysis preceded by the measurement invariance of composite models procedure (Henseler et al., 2016), re-estimation with control variables, tests for quadratic effects, and an importance–performance map analysis (Ringle & Sarstedt, 2016), for which construct scores were rescaled to a range of 0 to 100 and importance was expressed as the unstandardised total effect on patient satisfaction.

2.6 Validity, Reliability and Common Method Bias

Content validity was assessed by a panel of three academics in health services management and information systems and two primary care practitioners, who rated each item for relevance and clarity. The item-level content validity index ranged from 0.80 to 1.00, and the wording of four items was revised. A pilot test with 40 patients outside the main sample yielded Cronbach's alpha values between 0.79 and 0.88, and no item was removed. Because predictors and outcome were reported by the same respondents at one point in time, procedural and statistical remedies for common method bias were applied (Podsakoff et al., 2003). Procedurally, anonymity was guaranteed, respondents were told that there were no right or wrong answers, predictor and criterion items were separated in the questionnaire, and item wording was varied to avoid common stems. Statistically, Harman's single-factor test and the full collinearity assessment (Kock, 2015) were used. The results are reported in Section 3.7.

3. RESULTS

3.1 Respondent Profile

Table 2 presents the respondent profile. Women made up 60.2% of the sample, and 58.8% of respondents were under 40 years of age, which is consistent with the younger profile of digital service users, although 18.7% were 50 or older. About half held a bachelor's or postgraduate degree (49.6%). Puskesmas patients accounted for 59.5% of respondents and patients of private clinics or general practices for 40.5%, and 63.5% lived in urban areas. Three in ten reported a chronic condition requiring regular follow-up. The Mobile JKN doctor-consultation feature was the most common channel (48.9%), followed by messaging or video channels managed by the facility itself (36.5%).

In the six months before the survey, 41.0% had used teleconsultation once or twice, 37.9% three to five times and 21.1% six times or more.

Table 2. Respondent Profile (n = 427)

Characteristic	Category	n	%
Gender	Female	257	60.2
	Male	170	39.8
Age (years)	18–29	101	23.7
	30–39	150	35.1
	40–49	96	22.5
	50–59	62	14.5
	60 and over	18	4.2
Education	Senior high school or below	155	36.3
	Diploma	60	14.1
	Bachelor's degree	175	41.0
	Postgraduate degree	37	8.7
Facility type	Puskesmas	254	59.5
	Private primary clinic or general practice	173	40.5
Province	DKI Jakarta	105	24.6
	West Java	114	26.7
	East Java	84	19.7
	Bali	53	12.4
	South Sulawesi	71	16.6
Residence	Urban	271	63.5
	Peri-urban or rural	156	36.5
Chronic condition	Yes	128	30.0
	No	299	70.0
Main teleconsultation channel	Mobile JKN doctor-consultation feature	209	48.9
	Messaging or video channel managed by the facility	156	36.5
	Other platform linked to the facility	62	14.5
Teleconsultations in past six months	1–2	175	41.0
	3–5	162	37.9
	6 or more	90	21.1

Source: Authors' computation.

3.2 Measurement Model

Table 3 reports the measurement model. All 19 indicator loadings exceeded 0.708, ranging from 0.740 for the privacy item (PSQ6) to 0.890 for the item on fulfilled expectations (PS2), and all were significant at $p < 0.001$. Cronbach's alpha ranged from 0.882 to 0.910, ρA from 0.883 to 0.914 and composite reliability from 0.919 to 0.931. These values are above the 0.70 threshold and below 0.95, the level at which item redundancy becomes a concern. AVE ranged from 0.692 to 0.769, which establishes convergent validity. Construct means were above the scale midpoint. Telemedicine utilization had the lowest mean (3.42), whereas perceived service quality (3.78), technology acceptance (3.78) and patient satisfaction (3.80) were similar. Respondents thus evaluated the service more favourably than they described the intensity of their own use, which leaves room for the variation in utilization that the model requires. Among the quality items, reliability (PSQ1) had the lowest mean (3.62) and assurance (PSQ3) the highest (3.88). The utilization scale also behaved as intended against the separate frequency question: mean utilization scores rose from 2.75 among respondents reporting one or two teleconsultations to 3.61 for three to five and 4.38 for six or more (Spearman's $\rho = 0.74$, $p < 0.001$).

Table 3. Measurement Model: Loadings, Reliability and Convergent Validity

Construct	Item	Loading	Mean	SD	α	ρA	CR	AVE
Telemedicine utilization	TU1	0.854	3.51	1.00	0.882	0.883	0.919	0.739
	TU2	0.888	3.41	1.00				
	TU3	0.834	3.45	0.96				
	TU4	0.861	3.30	1.03				
Perceived service quality	PSQ1	0.832	3.62	0.96	0.910	0.914	0.931	0.692
	PSQ2	0.855	3.78	0.94				
	PSQ3	0.863	3.88	0.94				
	PSQ4	0.851	3.79	0.95				
	PSQ5	0.842	3.83	0.95				
	PSQ6	0.740	3.76	0.95				
Technology acceptance	TA1	0.859	3.85	0.96	0.904	0.907	0.928	0.722
	TA2	0.882	3.78	0.94				
	TA3	0.837	3.70	1.03				
	TA4	0.849	3.75	0.98				
	TA5	0.820	3.79	0.95				
Patient satisfaction	PS1	0.889	3.84	0.90	0.900	0.901	0.930	0.769
	PS2	0.890	3.77	0.96				
	PS3	0.867	3.89	0.92				
	PS4	0.862	3.72	0.94				

Note: α = Cronbach's alpha; CR = composite reliability; AVE = average variance extracted. Source: Authors' computation.

3.3 Discriminant Validity

Discriminant validity was supported by both criteria (Table 4). The square root of each construct's AVE (0.832 to 0.877) exceeded its correlations with all other constructs, the highest of which was between perceived service quality and patient satisfaction (0.695). HTMT values ranged from 0.433 to 0.766, below the conservative threshold of 0.85, and the upper bound of the 95% bootstrap confidence interval of the highest ratio was 0.816. No indicator loaded more highly on another construct than on its own. Perceived service quality and patient satisfaction, although closely related as theory predicts, are therefore empirically distinct.

Table 4. Discriminant Validity: Fornell–Larcker Criterion and HTMT

Construct	TU	PSQ	TA	PS
Telemedicine utilization (TU)	**0.860**	*0.581*	*0.433*	*0.628*
Perceived service quality (PSQ)	0.522	**0.832**	*0.460*	*0.766*
Technology acceptance (TA)	0.387	0.419	**0.850**	*0.490*
Patient satisfaction (PS)	0.560	0.695	0.445	**0.877**

Note: Diagonal (bold) = square root of AVE; below the diagonal = latent variable correlations; above the diagonal (italic) = HTMT ratios. Source: Authors' computation.

3.4 Structural Model and Hypothesis Tests

Collinearity was not a concern, with inner VIF values between 1.03 and 1.54 (Table 5). The model explained 35.2% of the variance in perceived service quality and 55.2% of the variance in patient satisfaction. Against the benchmarks of Hair et al. (2019), the first value lies between weak and moderate and the second is moderate. SRMR for the saturated model was 0.039, below the 0.08 guideline. Perceived service quality had a large effect on satisfaction ($f^2 = 0.381$), whereas utilization had a medium effect on perceived service quality ($f^2 = 0.251$) and a small effect on satisfaction ($f^2 = 0.086$). The interaction term had an f^2 of 0.038 on perceived service quality. This is large by the standards proposed for moderation, where 0.005, 0.01 and 0.025 mark small, medium and large effects (Hair et al., 2022).

Table 5. Structural Model Quality: Explained Variance, Effect Sizes and Collinearity

Endogenous construct	R^2	Adjusted R^2	Predictor	f^2	Inner VIF
Perceived service quality	0.352	0.348	Telemedicine utilization	0.251	1.186
			Technology acceptance	0.095	1.186
			TU × TA	0.038	1.027
Patient satisfaction	0.552	0.548	Telemedicine utilization	0.086	1.483
			Perceived service quality	0.381	1.544
			Technology acceptance	0.032	1.299
			TU × TA	0.000	1.066

Source: Authors' computation

Table 6 and Figure 3 report the hypothesis tests. Telemedicine utilization was positively related to patient satisfaction ($\beta = 0.239$, $t = 6.32$, $p < 0.001$), supporting H1, and to perceived service quality ($\beta = 0.439$, $t = 10.76$, $p < 0.001$), supporting H2. Perceived service quality was the strongest predictor of patient satisfaction ($\beta = 0.513$, $t = 12.89$, $p < 0.001$), supporting H3. The interaction between utilization and technology acceptance was positive and significant for perceived service quality ($\beta = 0.159$, $t = 3.79$, $p < 0.001$), supporting H5. It was not significant for the direct path to

satisfaction (β = −0.003, t = 0.09, p = 0.929), and the confidence interval was centred almost exactly on zero, so H6 was not supported. Technology acceptance also had direct positive effects on perceived service quality (β = 0.270) and on satisfaction (β = 0.138). Both were small by conventional benchmarks (f^2 = 0.095 and 0.032), so acceptance matters more for what it does to the effect of utilization than for its own contribution.

Table 6. Hypothesis Tests: Direct and Moderating Effects

Hyp.	Path	β	SE	t	p	95% CI	Decision
H1	TU → PS	0.239***	0.038	6.32	< 0.001	[0.165, 0.313]	Supported
H2	TU → PSQ	0.439***	0.041	10.76	< 0.001	[0.356, 0.518]	Supported
H3	PSQ → PS	0.513***	0.040	12.89	< 0.001	[0.432, 0.590]	Supported
H5	TU × TA → PSQ	0.159***	0.042	3.79	< 0.001	[0.075, 0.241]	Supported
H6	TU × TA → PS	−0.003	0.033	0.09	0.929	[−0.065,0.063]	Not supported
–	TA → PSQ	0.270***	0.045	6.02	< 0.001	[0.182, 0.358]	–
–	TA → PS	0.138***	0.038	3.66	< 0.001	[0.066, 0.211]	–

*Note: *** p < 0.001; two-tailed tests; 5,000 bootstrap resamples; percentile confidence intervals. Source: Authors' computation.*

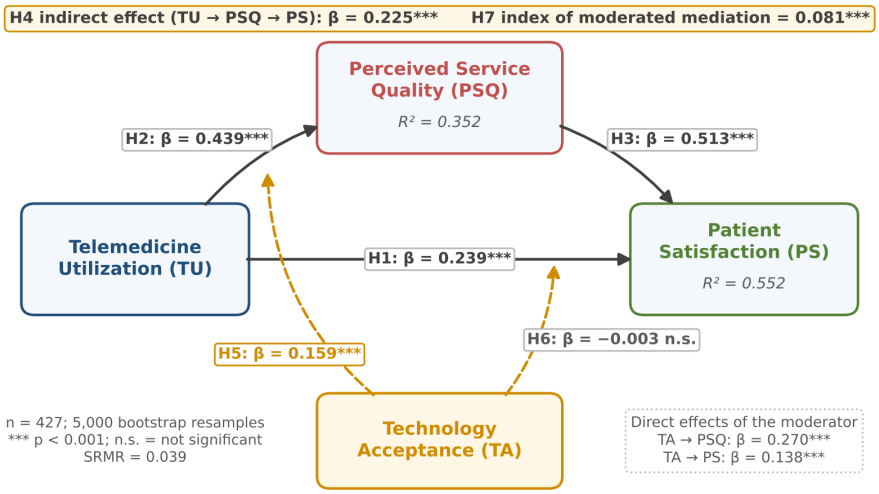

Figure 3. Structural Model Results

Source: Authors' computation.

3.5 Mediation and Moderated Mediation

Table 7 decomposes the effects. At the mean of technology acceptance, the indirect effect of utilization on satisfaction through perceived service quality was 0.225 (95% CI [0.174, 0.280]). The direct effect remained significant, giving a total effect of 0.464. Because the direct and indirect effects

are both significant and have the same sign, the pattern is complementary partial mediation (Zhao et al., 2010), with perceived service quality accounting for 48.5% of the total effect. H4 was supported.

Figure 4 plots the simple slopes. The effect of utilization on perceived service quality was 0.280 at low technology acceptance and 0.597 at high technology acceptance, a little more than twice as large, whereas the direct effect on satisfaction was virtually identical at the two levels (0.241 and 0.236). The index of moderated mediation was 0.081, and its confidence interval excluded zero (95% CI [0.039, 0.126]), supporting H7. As Figure 5 shows, the conditional indirect effect increased from 0.144 at low acceptance to 0.225 at the mean and 0.307 at high acceptance, and it was significant at all three levels. Technology acceptance therefore amplifies the mediated pathway rather than switching it on: even patients with low acceptance derive some satisfaction from use through perceived quality, but considerably less.

Table 7. Effect Decomposition, Simple Slopes and Conditional Indirect Effects

Effect	Estimate	SE	t	95% CI	Interpretation
Direct effect, TU → PS	0.239	0.038	6.32	[0.165, 0.313]	Significant
Indirect effect, TU → PSQ → PS (mean TA)	0.225	0.027	8.41	[0.174, 0.280]	H4 supported
Total effect, TU → PS	0.464	0.037	12.55	[0.389, 0.534]	VAF = 48.5%
Slope TU → PSQ at low TA (−1 SD)	0.280	0.059	4.71	[0.161, 0.396]	Significant
Slope TU → PSQ at high TA (+1 SD)	0.597	0.057	10.43	[0.486, 0.711]	Significant
Slope TU → PS at low TA (−1 SD)	0.241	0.046	5.27	[0.152, 0.331]	Significant
Slope TU → PS at high TA (+1 SD)	0.236	0.054	4.40	[0.132, 0.340]	Significant
Conditional indirect effect, low TA	0.144	0.033	4.42	[0.082, 0.209]	Significant
Conditional indirect effect, mean TA	0.225	0.027	8.41	[0.174, 0.280]	Significant
Conditional indirect effect, high TA	0.307	0.037	8.31	[0.237, 0.383]	Significant
Index of moderated mediation	0.081	0.022	3.66	[0.039, 0.126]	H7 supported

Note: VAF = variance accounted for (indirect effect / total effect). Source: Authors' computation.

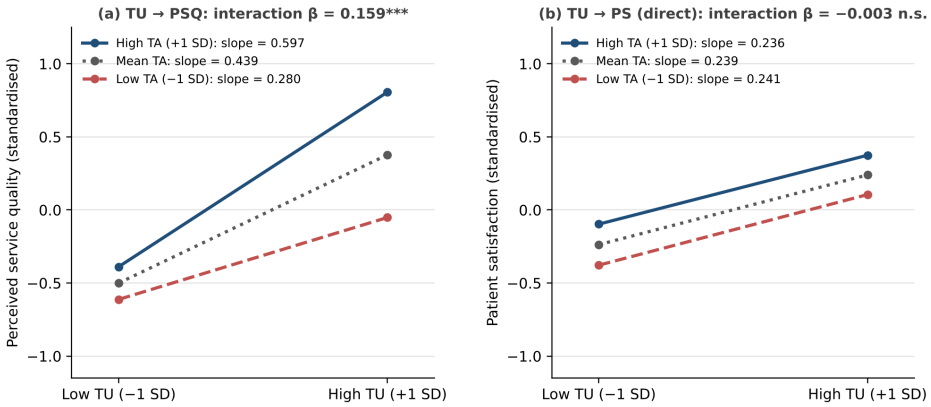

Figure 4. Simple Slopes of Telemedicine Utilization at Low, Mean and High Technology Acceptance

Source: Authors' computation.

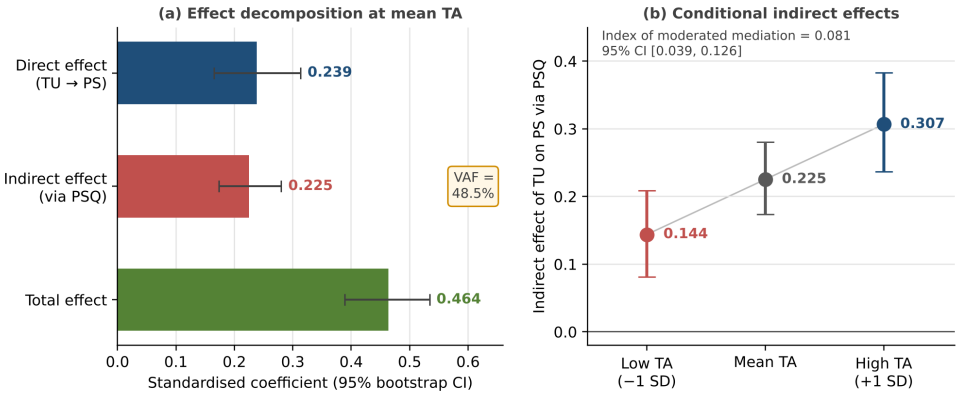

Figure 5. Effect Decomposition and Conditional Indirect Effects

3.6 Multigroup Analysis

Two groupings were examined: facility type (Puskesmas versus private clinic or practice) and age (under 40 versus 40 and over). Compositional invariance was established for all constructs in both groupings (correlations between group-specific composites of at least 0.999; permutation $p > 0.05$). For facility type, composite means and variances were also equal across groups, indicating full measurement invariance. For age, the mean of technology acceptance and the variance of utilization differed, so invariance was partial, which is sufficient for comparing path coefficients (Henseler et al., 2016).

Table 8 shows that the path from utilization to perceived service quality was significantly weaker among Puskesmas patients ($\beta = 0.329$) than among patients of private clinics ($\beta = 0.578$; difference = −0.249, permutation $p = 0.003$). Explained variance in perceived service quality was correspondingly lower in the Puskesmas group ($R^2 = 0.336$ versus 0.430). The differences in the indirect effect (0.183 versus 0.277) and in the moderating effect on the direct path did not reach significance at the 5% level ($p = 0.084$ and $p = 0.060$), and no other path differed. The moderating

effect on perceived service quality was numerically larger in the Puskesmas group (0.222 versus 0.093), but the difference was not significant (p = 0.138). The direct path to satisfaction was similar in the two groups (0.260 versus 0.214), so the facility difference is specific to how use relates to perceived quality. No path differed significantly between the two age groups.

Table 8. Multigroup Analysis by Facility Type and Age Group

Path	Puskesmas (n = 254)	Private (n = 173)	Diff.	p	Under 40 (n = 251)	40+ (n = 176)	Diff.	p
TU → PSQ	0.329	0.578	−0.249	0.003*	0.444	0.430	0.014	0.868
PSQ → PS	0.557	0.479	0.078	0.344	0.526	0.490	0.036	0.664
TU → PS	0.260	0.214	0.046	0.540	0.233	0.250	−0.017	0.828
TU × TA → PSQ	0.222	0.093	0.129	0.138	0.096	0.224	−0.128	0.138
TU × TA → PS	−0.063	0.059	−0.122	0.060	−0.013	−0.013	0.000	0.995
Indirect effect (TU → PSQ → PS)	0.183	0.277	−0.094	0.084	0.234	0.211	0.023	0.681

*Note: * p < 0.05; p-values from permutation tests with 2,000 permutations. Source: Authors' computation.*

3.7 Robustness Checks and Importance–Performance Analysis

Table 9 summarises the robustness checks. Adding the six control variables to both equations left the hypothesised coefficients essentially unchanged (largest change = 0.009) and raised R^2 only marginally, to 0.358 and 0.565. Among the controls, only gender was significant: women reported somewhat higher satisfaction (β = 0.082, p = 0.012). Quadratic terms for utilization and perceived service quality were small and non-significant, giving no indication of diminishing or accelerating returns within the observed range. In the PLSpredict analysis, all ten indicators of the endogenous constructs had positive Q^2predict values (0.163 to 0.337) and a lower RMSE under the PLS model than under the linear benchmark, which indicates high out-of-sample predictive power (Shmueli et al., 2019). The best-predicted indicator was PS2 (Q^2predict = 0.337) and the least well predicted was the privacy item PSQ6 (0.163). Regarding common method bias, the first unrotated factor accounted for 46.0% of the variance, below the 50% criterion, and full collinearity VIFs ranged from 1.32 to 2.23, below 3.3 (Kock, 2015).

Table 9. Robustness Checks

Check	Result	Assessment
Model with six control variables	TU → PSQ = 0.448; PSQ → PS = 0.511; TU → PS = 0.239; TU × TA → PSQ = 0.158; TU × TA → PS = −0.007	Hypothesised paths unchanged (largest change = 0.009)
Significant control variables	Gender (female) → PS: β = 0.082, p = 0.012	All other controls non-significant
Quadratic effect, TU² → PSQ	β = −0.030, p = 0.412	No non-linearity
Quadratic effect, TU² → PS	β = 0.006, p = 0.825	No non-linearity
Quadratic effect, PSQ² → PS	β = −0.006, p = 0.849	No non-linearity
PLSpredict (10 folds)	Q²predict = 0.163–0.337; RMSE lower for PLS than for the linear model on 10 of 10 indicators	High predictive power
Harman's single-factor test	First factor = 46.0% of variance	Below 50%
Full collinearity VIF	1.32–2.23	Below 3.3
SRMR (saturated model)	0.039	Below 0.08

Note: Control variables = age, gender, education, chronic condition, facility type and residence. Source: Authors' computation.

The importance–performance map (Figure 6) adds a managerial reading. Perceived service quality combined the highest importance for satisfaction (unstandardised total effect = 0.529) with a performance score of 69.5 out of 100. Telemedicine utilization was also of above-average importance (0.433) but had the lowest performance (60.5), which places it in the quadrant where improvement yields the most. In the metric of the map, a one-point increase in the performance of perceived service quality is associated with an increase of 0.529 points in patient satisfaction, compared with 0.433 for utilization and 0.265 for technology acceptance. Within perceived service quality, the reliability item had the lowest performance (65.5) and the assurance item the highest (72.0). Figure 7 summarises the principal findings.

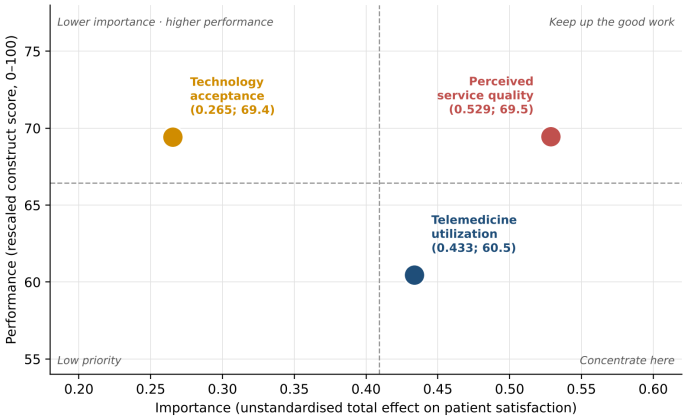

Figure 6. Importance–Performance Map for Patient Satisfaction

Note: Dashed lines mark the mean importance and mean performance of the three predictors. Source: Authors' computation.

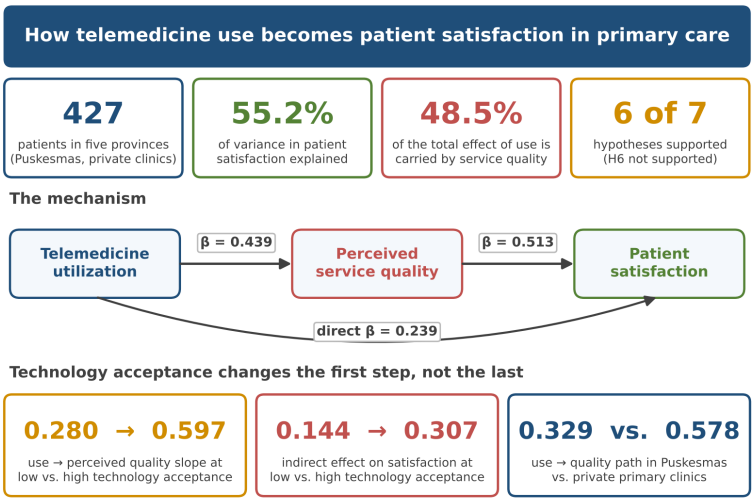

Figure 7. Summary of Principal Findings

Source: Authors' computation.

4. DISCUSSION

4.1 Interpretation of the Main Findings

The findings show that telemedicine utilization increases patient satisfaction mainly through perceived service quality, which mediates nearly half of the relationship. Service quality (β = 0.513) has a stronger influence on satisfaction than utilization directly (β = 0.239), highlighting the importance of reliable, responsive, and competent services.

Technology acceptance strengthens the relationship between utilization and perceived service quality, with the indirect effect on satisfaction approximately twice as large among highly accepting users. However, acceptance does not moderate the direct utilization–satisfaction relationship, indicating that technological readiness primarily influences quality perceptions rather than convenience benefits.

The multigroup analysis also reveals that the utilization–quality relationship is weaker in Puskesmas than in private clinics, potentially due to heavier workloads and operational constraints. Furthermore, reliability was the weakest-performing component of service quality, highlighting the need to improve service consistency and minimize interruptions.

4.2 Dialogue with Prior Literature

These findings extend previous telemedicine satisfaction research by showing that satisfaction increases with utilization, primarily through perceived service quality (Kruse et al., 2017; Orlando et al., 2019). The relationship between service quality and satisfaction (β = 0.513) was stronger than that reported by Khatun et al. (2024) (β = 0.327), potentially reflecting the continuity of provider–patient relationships in registered healthcare facilities.

The findings also extend technology acceptance research by demonstrating that acceptance remains important even after adoption, influencing both satisfaction and the relationship between utilization and perceived quality (Kamal et al., 2020; Baudier et al., 2021; Alexandra et al., 2021). Although acceptance varies across age groups, structural relationships did not differ significantly between younger and older patients, suggesting that age may operate through technology acceptance (Baudier et al., 2021; Bashshur et al., 2016).

Additionally, women reported slightly higher satisfaction, contrasting with Ramaswamy et al. (2020). The weaker utilization–quality relationship in Puskesmas also supports previous findings that connectivity remains an obstacle in public primary care facilities (Indria et al., 2020).

4.3 Theoretical Implications

The study offers three theoretical contributions. First, it extends the information systems success model by showing that telemedicine use influences satisfaction through service quality perceptions formed during use, suggesting a recursive relationship between use, quality, and satisfaction (DeLone & McLean, 2003).

Second, it extends the technology acceptance model by demonstrating that perceived usefulness and ease of use remain important after adoption, influencing how effectively utilization translates into perceived quality (Davis, 1989; Venkatesh et al., 2003; Holden & Karsh, 2010).

Third, it extends expectation–confirmation theory by showing that the relationship between utilization and satisfaction depends on user capability and organisational capacity, rather than utilization alone (Bhattacherjee, 2001; Oliver, 1980). This finding also supports Donabedian's (1988) distinction between healthcare structure and process. Overall, the study establishes a moderated mediation model in which the effect of utilization on service quality depends on technology acceptance and facility context.

4.4 Practical and Managerial Implications

For primary care managers, the findings highlight service quality, particularly reliability, as the main driver of patient satisfaction. Practical improvements include clear consultation hours, response-time standards, assigned staff, structured follow-up messages, and procedures for referring patients to in-person care.

For insurers and platform developers, technology acceptance should be strengthened through guided consultations, simple navigation, clear symptom-reporting instructions, and registration assistance. The transition from text-based chat to clinician-initiated video, piloted in Mobile JKN in late 2024 (Purwanti, 2024), should consider differences in patients' technological readiness.

For regulators and health authorities, the weaker relationship between telemedicine use and service quality in Puskesmas highlights the need for better connectivity and staffing, particularly in

rural areas (Asosiasi Penyelenggara Jasa Internet Indonesia, 2024). Monitoring should go beyond consultation volume by including timeliness and patient-reported quality. Completed teleconsultations are already recorded in primary care information systems (Purwanti, 2024), while service standards should follow international guidance for integrating telemedicine into routine healthcare (World Health Organization, 2022).

4.5 Alternative Explanations and Validity Considerations

Three limitations should be considered. First, reverse causality cannot be excluded because satisfied patients may use telemedicine more frequently (Bhattacherjee, 2001). However, the six-month utilization measure and current quality evaluations support the hypothesised direction. Second, the sample included only previous teleconsultation users, limiting generalisation to non-users and potentially increasing average satisfaction. Third, common method variance is a concern because all variables were self-reported. Nevertheless, full collinearity VIFs were below 3.3 (Kock, 2015), and interaction effects are unlikely to be artificially generated by common method variance (Siemsen et al., 2010). Although control variables did not change the estimates, unmeasured factors such as health status and continuity of care may still influence the results (Rolando, 2025a).

4.6 Boundary Conditions

The findings apply most directly to adult patients who already use teleconsultation offered by, or linked to, the primary care facility where they are registered, in a system financed largely by capitation. Four conditions limit transfer to other settings. The consultations were predominantly text-based and concerned non-urgent complaints, follow-up and prescription renewal; where video is standard, or where telemedicine substitutes for urgent care, both the quality attributes that matter and the role of acceptance may differ. The patient usually consulted a provider at a facility they knew, which is not the case on commercial platforms that match patients to any available doctor. The sample came from five provinces with comparatively good infrastructure and was mostly urban, so in remote districts connectivity may dominate every other determinant. Finally, the facility-to-facility services covered by the 2019 ministerial regulation, in which the user is a clinician rather than a patient, fall outside the model altogether. Within these limits, the absence of differences across age groups and the stability of the estimates under controls suggest that the core mechanism is not confined to a narrow demographic segment.

4.7 Limitations

Several limitations should be acknowledged. First, the cross-sectional design limits causal conclusions. Second, self-reported utilization may be less accurate than platform usage records. Third, purposive sampling across five provinces limits generalisability and may introduce selection bias. Fourth, service quality was measured as a single construct, preventing analysis of individual quality dimensions. Fifth, technology acceptance was measured after adoption, potentially reflecting prior service experiences. Sixth, satisfaction does not establish clinical effectiveness or patient safety. Finally, the facility-type comparison was exploratory and requires further validation.

4.8 Future Research Agenda

Future research should use longitudinal designs combining surveys and platform usage records to examine the reciprocal relationships between utilization, service quality, and satisfaction. Multilevel studies should also assess whether facility resources, such as internet connectivity and clinician availability, explain differences between Puskesmas and private clinics. Field experiments could evaluate whether assisted onboarding improves technology acceptance and service quality. Further research should examine technical, interpersonal, and outcome dimensions of service quality as higher-order constructs (Akter et al., 2013). Finally, studies should incorporate clinical outcomes, such as medication adherence and blood pressure control, and extend investigations to rural patients, former telemedicine users, and video-based consultations.

5. CONCLUSION

This study found that telemedicine utilization positively influences patient satisfaction, with perceived service quality mediating 48.5% of the total effect. Technology acceptance strengthens the relationship between utilization and service quality, making the indirect effect approximately twice as strong among highly accepting users. The model explained 55.2% of the variance in patient satisfaction, with high predictive power.

The study contributes an integrated understanding of how telemedicine utilization, service quality, and technology acceptance shape patient satisfaction. Practically, improving telemedicine requires not only expanding access but also strengthening service reliability, responsiveness, and support for less confident users. In Indonesia and comparable countries, healthcare providers should prioritize dependable service routines and technology assistance to ensure positive patient experiences. Future research should use longitudinal data combining patient perceptions, usage records, and clinical outcomes to assess long-term impacts on healthcare quality.

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