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From Relational Care Quality to Digital Health Literacy: The Mediating Role of Patient Engagement and Moderating Role of Patient Satisfaction

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ABSTRACT

Purpose – Indonesian regional hospitals face pressure to expand digital health services, yet whether patient engagement builds the digital literacy needed to use them, and under what conditions, remains untested. This study examined whether perceived care continuity, practitioner communication, and perceived empathic care predict patient digital literacy directly and indirectly through patient engagement, and whether patient satisfaction moderates the engagement-to-digital-literacy path.
Design/methodology/approach – This study used partial least squares structural equation modeling (PLS-SEM) on data from 400 patients across three Type B hospitals in Makassar, Indonesia.
Finding/Results – All three relational care quality constructs significantly predicted patient engagement (R^2 = .499), which significantly predicted digital literacy (β = .531, R^2 = .475). Care continuity and communication retained significant direct effects on digital literacy, while empathic care operated entirely through engagement. Patient satisfaction alone did not predict digital literacy, but its interaction with engagement was significant (β = .238), nearly tripling the effect from β = .293 among less-satisfied patients to β = .769 among more-satisfied patients. Confirmatory tetrad analysis supported the reflective measurement model, and reliability and validity criteria were met.
Originality/Value – Findings suggest patient engagement functions as a developmental pathway to digital literacy, conditional on satisfaction, offering hospital managers a sequencing rationale for pairing digital-service rollouts with service-quality improvement.

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1. Introduction

Indonesia's Ministry of Health has tied a portion of regional hospital accreditation and BPJS Kesehatan reimbursement adjustments to patient experience indicators, pushing Type B regional general hospitals (RSUD) to treat patient satisfaction as an operational priority rather than a public relations exercise. In Makassar, three RSUD units, Labuang Baji, Haji Makassar, and Kota Makassar, serve patients from markedly different socioeconomic backgrounds while competing for the same limited pool of specialist staff and digital infrastructure investment. Hospital managers in this setting face a genuine allocation problem: should scarce resources go toward improving continuity of care, training staff in communication and empathy, building patient engagement programs, or expanding digital literacy support? The answer depends on which mechanism actually builds patient engagement and, through it, the digital competence patients need to use these services, and current evidence does not agree.

A large stream of health services research treats relational care quality, commonly operationalized through care continuity, provider communication, and empathic behavior, as a foundational driver of patient satisfaction. Grounded in relationship marketing and patient-centered care theory, this literature argues that patients form satisfaction judgments largely from the quality of their interpersonal experience with providers rather than from clinical outcomes alone. More recently, patient engagement has entered this literature as the behavioral and psychological mechanism through which relational quality is thought to convert into satisfaction, on the logic that patients who feel involved in their own care evaluate that care more favorably.

Recent evidence on this specific link is inconsistent. Alharbi et al. (2026), studying patients with chronic conditions in Saudi outpatient clinics, found no statistically significant relationship between patient engagement in decision-making and patient satisfaction, reporting an R^2 of only 0.001. In direct contrast, Keelson et al. (2024), using PLS-SEM on a sample of 320 healthcare professionals across public hospitals in Ghana, found that patient engagement carries a significant positive effect on patient satisfaction and customer well-being. Same construct, same general relationship, opposite verdicts. The divergence suggests that the engagement-satisfaction link is conditional rather than universal, plausibly depending on how strongly the antecedent relational conditions are met and on patient-level factors such as digital capability that symmetric average-effect models tend to overlook.

This study responds to that contradiction directly. It tests whether perceived care continuity, practitioner communication, and perceived empathic care influence patient engagement, whether engagement in turn builds patient digital literacy both directly and indirectly, and whether patient satisfaction moderates the strength of the engagement-to-digital-literacy path. The study applies PLS-SEM, appropriate for a moderated mediation model with formative and reflective elements, on a planned sample of 400 patients drawn from three Type B RSUD in Makassar using a multi-site design.

The contribution is twofold. Theoretically, the study offers an explanation for the Alharbi-Keelson contradiction by testing digital literacy as a boundary condition rather than treating engagement's effect as fixed. Practically, the findings will help RSUD managers decide whether to prioritize interpersonal service training, engagement programs, or digital literacy support, and in what sequence. The following section develops the theoretical background and hypotheses that structure this test.

2. Theoretical Background & Hypothesis Development

2.1 Underpinning Theory

The model draws on relationship marketing theory and patient-centered care theory. Relationship marketing theory holds that trust and commitment, built through repeated favorable interactions, mediate the link between service quality and downstream customer behavior, including the willingness to adopt channels a provider makes available. Patient-centered care theory extends this logic to healthcare by treating the patient as an active participant rather than a passive recipient, positing that involvement in one's own care, patient engagement, shapes what a patient subsequently does with that involvement.

Together these perspectives justify placing patient engagement as a mediator between relational care quality and patient digital literacy, on the reasoning that patients who feel actively involved in their own care are more motivated to seek out, practice with, and become competent in the digital channels through which that care is increasingly delivered. Patient satisfaction is positioned as a moderator of the engagement-to-digital-literacy path rather than as a mediator or a fifth direct predictor, since a patient's affective evaluation of the care encounter plausibly determines whether the motivational resources built through engagement are redirected toward learning new digital tools or instead absorbed by dissatisfaction with the service itself.

2.2 Perceived Care Continuity and Patient Engagement

Perceived care continuity (PCC) reflects a patient's sense that their care is delivered by a consistent, coordinated team over time rather than fragmented across unfamiliar providers. Chen and Cheng (2023), applying an instrumental variable approach to a nationwide sample of 1,715 elderly patients in Taiwan, found a strong significant association between patient-reported continuity and patient satisfaction, and argued that continuity operates by building the trust and familiarity that make patients willing to participate actively in their own care decisions. When patients see the same provider repeatedly, they accumulate the relational capital needed to ask questions, raise concerns, and engage in shared decision-making rather than deferring passively. This mechanism positions continuity as an antecedent of engagement rather than a direct driver of satisfaction alone. Cha (2025), analyzing Korea's 2023 Healthcare Service Experience Survey, similarly found that information sharing and shared decision-making, both continuity-dependent behaviors, had a significant positive effect on outpatient satisfaction among chronic disease patients. Based on this evidence, the following hypothesis is proposed.

H1: Perceived care continuity has a significant positive effect on patient engagement.

2.3 Practitioner Communication and Patient Engagement

Practitioner communication (PC) captures the clarity, responsiveness, and two-way character of provider-patient exchanges. Keelson et al. (2024) found that practitioner-patient communication positively affects patient satisfaction and that this effect is carried through patient trust, a psychological state closely linked to engagement, since a patient who trusts a provider is more willing to disclose information and participate in decisions. Cha (2025) reported that communication with healthcare providers had one of the strongest positive associations with satisfaction in the Korean HSES sample, ahead of most other service dimensions. Peimani et al. (2024), studying 1,143 patients with type 2 diabetes, found that patient-physician communication strengthened the positive effect of health information-seeking on self-care behavior, indicating that communication quality determines how actively patients translate information into engaged action rather than passive receipt. These findings converge on communication as a direct behavioral trigger for engagement.

H2: Practitioner communication has a significant positive effect on patient engagement.

2.4 Perceived Empathic Care and Patient Engagement

Perceived empathic care (PEC) reflects a patient's sense that providers understand and respond to their emotional state, not only their clinical needs. Mei, Xu, and Li (2020), testing a PLS-SEM model across two public hospitals in China, found that provider empathy significantly affected both patient trust and patient satisfaction, and that empathy operated through patient engagement behaviors such as compliance and loyalty rather than affecting outcomes in isolation. Their functional quality framework treats empathy as one of the strongest touchpoints shaping whether patients feel safe enough to engage openly with the care process. Where empathy is low, patients withhold concerns and defer decisions entirely to providers, a pattern inconsistent with active engagement. Where empathy is high, patients report greater willingness to ask questions and participate, consistent with the trust-engagement pathway identified in the same study.

H3: Perceived empathic care has a significant positive effect on patient engagement.

2.5 Relational Care Quality and Patient Digital Literacy: Direct Effects

Beyond their indirect influence through engagement, PCC, PC, and PEC are each expected to retain a direct effect on patient digital literacy, consistent with a partial rather than full mediation structure. A consistent provider team can walk a patient through a portal login during an ordinary visit; clear communication can explain what a lab-result notification means without the patient first feeling emotionally engaged. Bonifanti et al. (2025) found eHealth literacy remained significantly associated with patient activation after controlling for sociodemographic factors, consistent with structural features of the care relationship, not affect alone, carrying some of that association. Deshpande et al. (2023) similarly found eHealth literacy predicted patient portal awareness and use largely independent of the emotional register of the clinical encounter, which points toward continuity and communication, the more procedural dimensions of relational quality, as more likely to retain a direct path to digital literacy than empathy does. Testing both direct and indirect paths allows the data, rather than a full-mediation assumption, to determine whether engagement fully or only partially explains the relational quality to digital literacy link, following the logic that an assumed full-mediation model risks misattributing a genuine direct effect to a spurious indirect one.

H4: Perceived care continuity has a significant positive effect on patient digital literacy.

H5: Practitioner communication has a significant positive effect on patient digital literacy.

H6: Perceived empathic care has a significant positive effect on patient digital literacy.

2.6 Patient Engagement and Patient Digital Literacy

Whether engagement builds digital literacy, rather than the more conventional assumption that digital literacy is a fixed trait patients bring into the encounter, is the pivotal link this study tests. Bonifanti et al. (2025), controlling for sociodemographic factors in a chronic-disease sample, found eHealth literacy significantly associated with patient activation and noted explicitly that activated patients may seek out and build digital skills as an extension of their engagement, rather than digital skill being a precondition for activation. Shiu et al. (2025) found that relationally driven constructs such as social support fed into eHealth literacy, which then drove technology acceptance, in a Taiwanese chronic-illness sample, supporting a pathway in which motivational and relational factors convert into digital capability. Marzban et al. (2022), synthesizing 17 studies in a scoping review, concluded that patient engagement improves treatment outcomes and self-efficacy more broadly, a pattern consistent with engagement also building the practical competence needed to use digital health tools. This study tests that developmental account directly, treating the boundary condition under which it holds, patient satisfaction, as the moderator specified in Section 2.8.

H7: Patient engagement has a significant positive effect on patient digital literacy.

2.7 Mediating Role of Patient Engagement

If H1 through H3 and H7 are each supported, patient engagement functions as a mediator carrying part of the effect of relational care quality onto patient digital literacy. This mediated pathway is theoretically distinct from the direct paths in H4 through H6, because it captures the behavioral conversion of relational quality into active participation rather than a purely procedural transfer of skill. Following the logic set out by Mei et al. (2020), where empathy and responsiveness reached a downstream outcome partly through trust and engagement rather than directly alone, this study specifies three indirect-effect hypotheses corresponding to each relational quality construct, tested through bootstrapped indirect effects in PLS-SEM rather than assumed from the direct-effect literature alone.

H8a: Patient engagement mediates the effect of perceived care continuity on patient digital literacy.

H8b: Patient engagement mediates the effect of practitioner communication on patient digital literacy.

H8c: Patient engagement mediates the effect of perceived empathic care on patient digital literacy.

2.8 Moderating Role of Patient Satisfaction

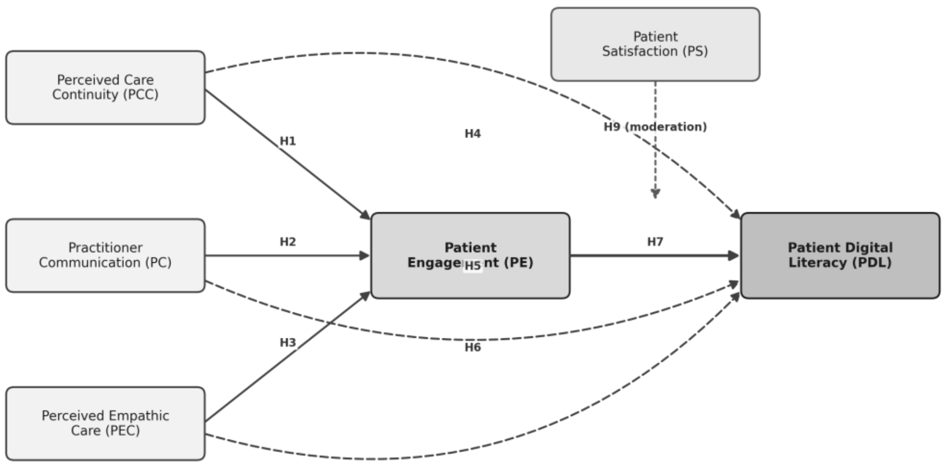
Patient satisfaction (PS) is proposed as a boundary condition on the engagement-to-digital-literacy path rather than a direct antecedent of engagement or a fifth direct predictor of digital literacy, on the reasoning that a patient's affective evaluation of the care encounter determines how much of the motivational capital built through engagement is actually redirected toward learning new digital skills rather than absorbed by dissatisfaction with the service itself. Peimani et al. (2024) found that e-health literacy significantly moderated the relationship between online health information-seeking and self-care outcomes among patients with type 2 diabetes, strengthening the positive effect for patients with higher literacy; this study reverses the roles in that logic, testing whether an analogous amplifying mechanism operates when satisfaction, rather than digital literacy itself, is the conditioning variable. Dissatisfaction plausibly narrows a patient's attention to the immediate service problem, crowding out the exploratory behavior needed to build digital competence, while satisfaction frees up cognitive and motivational resources for that exploration. This moderating pattern also offers a plausible explanation for the Alharbi-Keelson contradiction identified in the Introduction: samples in which patients are, on average, less satisfied with their care, such as the Saudi chronic-disease clinic sample studied by Alharbi et al. (2026), may show a weaker link between engagement and any downstream outcome, while samples with a more favorable service climate, such as the Ghanaian public-hospital sample studied by Keelson et al. (2024), may show that link more clearly. Testing PS as a moderator, rather than as a fourth direct predictor, allows this study to evaluate that boundary-condition explanation directly.

H9: Patient satisfaction moderates the effect of patient engagement on patient digital literacy, such that the effect is stronger among patients with higher satisfaction.

2.9 Conceptual Model

The conceptual model specifies perceived care continuity, practitioner communication, and perceived empathic care as exogenous constructs, each with a direct path to patient digital literacy (H4-H6) and an indirect path through patient engagement (H1-H3, H7, mediated as H8a-H8c). Patient satisfaction is specified as a moderator on the patient engagement to patient digital literacy path (H9), interacting with engagement rather than entering as a fifth direct predictor. The model therefore combines partial mediation with moderation on the final structural path, commonly reported in PLS-SEM as moderated mediation using the two-stage approach for interaction term formation.

Figure 1. Conceptual Research Model



3. Methodology

3.1 Research Paradigm and Design

This study adopts a positivist paradigm, consistent with its aim of testing pre-specified hypotheses about measurable relationships among latent constructs. The design is quantitative, cross-sectional, and explanatory, using a single-wave survey administered across three sites. PLS-SEM is selected over covariance-based SEM because the model combines a moderated interaction term with a partial mediation structure, a specification for which PLS-SEM's variance-based estimation and bootstrapping procedures are well suited, and because the study prioritizes prediction of patient digital literacy over strict confirmatory theory testing.

3.2 Population and Sample

The population comprised adult outpatients and inpatients at three Type B RSUD in Makassar, South Sulawesi: RSUD Labuang Baji, RSUD Haji Makassar, and RSUD Kota Makassar. Data collection was conducted over three months, one month per site, using a multi-site design to increase sample variability and enable multi-group analysis. Sample size was determined a priori using a power analysis in G*Power 3.1 and the 10-times rule (Hair et al., 2022), and re-verified post hoc in SmartPLS 4 across every path in the final model rather than the largest indicator count alone: N = 400 gave at least 71% achieved power (α = .05) for every significant path, and ≥99% power for seven of the ten paths; the one path with low achieved power (Patient Satisfaction → Patient Digital Literacy, f^2 = 0.002) was correctly non-significant. Respondents were selected using purposive sampling, restricted to patients with at least one prior visit to the same facility so they could meaningfully report on care continuity.

The target of 400 was allocated proportionally to routine patient volume: 135 to RSUD Labuang Baji, 135 to RSUD Haji Makassar, and 130 to RSUD Kota Makassar (Table 1), exceeding the minimum of 130 per site needed for the three-way multi-group comparison. The three sites were chosen to capture variation across comparable public hospitals within one urban healthcare system, allowing the hypothesized relationships to be tested for consistency across institutional contexts.

Respondents were eligible if they were at least 18 years old, had at least one prior visit to the same hospital, had adequate cognitive capacity to complete the questionnaire independently, were currently receiving or had just completed care during the data-collection period, and were willing to give informed consent. Patients were excluded if acutely distressed, sedated, in emergency care, unable to read Bahasa Indonesia, or clinically or cognitively unable to complete the questionnaire independently. No patient excluded on this last ground was permitted a caregiver-supplied rating: a caregiver could assist only with reading item text aloud or recording the patient's own verbal responses, never with independently assessing the patient's experience. Of the realized N = 400 sample, 200 respondents (50.0%) completed the questionnaire entirely on their own, reading each item and recording their own responses without assistance; the remaining 200 (50.0%) received reading/recording assistance from an accompanying caregiver, meaning the caregiver read item text aloud or wrote down the patient's own spoken answers. In both groups, every rating on the subjective constructs (Patient Engagement, Patient Satisfaction, Perceived Care Continuity, Perceived Empathic Care, Practitioner Communication) originated from the patient; no case departed from the protocol by having a caregiver supply an independent judgment on the patient's behalf.

Recruitment followed a stratified quota approach proportional to each hospital's routine census, by service type (outpatient/inpatient) and age group (18–39, 40–59, ≥60), with field staff rotated across morning and afternoon sessions to avoid time-of-day bias (Table 1). Selection bias was further controlled by monitoring quota attainment throughout the field period and logging all screened, eligible, declining, and excluded cases on a recruitment tracking sheet; any stratum shortfall was filled only from the same stratum and hospital, never substituted from elsewhere. Alongside the core constructs, field staff recorded smartphone ownership and internet access, service type, age group, diagnosis category, prior-visit history, hospital site, recruitment session, and any caregiver reading/recording assistance, for description, covariate, and protocol-compliance purposes.

Table 1. Sampling Quota Framework and Allocation by Site

Site	Target Sample	Outpatient Quota	Inpatient Quota	Age 18–39	Age 40–59	Age ≥ 60	Recruitment Session
RSUD Labuang Baji (Site 1)	135	Proportional to routine census	Proportional to routine census	Proportional to patient distribution	Proportional to patient distribution	Proportional to patient distribution	Morning and afternoon
RSUD Haji Makassar (Site 2)	135	Proportional to routine census	Proportional to routine census	Proportional to patient distribution	Proportional to patient distribution	Proportional to patient distribution	Morning and afternoon

Site	Target Sample	Outpatient Quota	Inpatient Quota	Age 18–39	Age 40–59	Age ≥ 60	Recruitment Session
RSUD Kota Makassar (Site 3)	130	Proportional to routine census	Proportional to routine census	Proportional to patient distribution	Proportional to patient distribution	Proportional to patient distribution	Morning and afternoon
Total	**400**	**Based on combined census**	**Based on combined census**	**Based on combined distribution**	**Based on combined distribution**	**Based on combined distribution**	**Morning and afternoon**

Because the multi-site design was intended to support multi-group analysis, measurement invariance across the three hospitals was established before any structural path was compared between sites, following the three-step MICOM procedure of Henseler, Ringle, and Sarstedt (2016); only constructs achieving at least partial invariance were carried forward to the multi-group comparison. Full MICOM and multi-group analysis results are reported in Section 4.5.

3.3 Instrument

All constructs were measured using multi-item, seven-point Likert scales (1 = strongly disagree, 7 = strongly agree). Rather than developing new items, this study adapted six previously validated, peer-reviewed instruments, one per construct, so that every measure had an established evidence base for reliability and validity. Table 2 lists the operational definition, item count, and source instrument for each construct. Because the study was administered in Bahasa Indonesia, all items were forward-translated and independently back-translated by two bilingual experts, with discrepancies resolved through reconciliation discussion before pilot testing. A pilot test with a small independent sample (n = 30) assessed content and face validity in the Indonesian hospital context; no items were dropped, and only minor wording adjustments were made before full data collection.

All six constructs were modeled as reflective and treated as unidimensional, a choice that requires explicit justification for Patient Satisfaction and Practitioner Communication because their source instruments were designed to span several conceptually distinct facets. The PSQ-18 (Marshall & Hays, 1994) covers interpersonal manner, communication, technical quality, financial aspects, time spent with the provider, and accessibility, and the 15-item Communication Assessment Tool (Makoul et al., 2007) similarly spans clarity, openness, and responsiveness. High internal consistency alone, as reported for both instruments in prior validations, does not by itself establish that these facets collapse into a single latent trait in a given sample; a homogeneous reflective specification was retained here as the a priori model because both instruments are conventionally scored as single indices in the hospital-satisfaction and communication literature this study draws on. This assumption was then checked empirically, rather than assumed, in two ways: item-level correlations and exploratory factor structure examined during pilot testing showed no clearly separating facet for either instrument, and the confirmatory tetrad analysis reported in Section 4.1 subsequently confirmed a reflective specification for both Patient Satisfaction and Practitioner Communication on the full N = 400 sample (0% of Bonferroni-adjusted tetrad confidence intervals excluded zero for either construct), supporting the homogeneous reflective model retained throughout the analysis.

Table 2. Operational Definition of Variables

Variable	Operational Definition	Items	Adapted From
Perceived Care Continuity (PCC)	The patient's perception that their care is delivered by a consistent, familiar, and well-coordinated provider team over time, rather than fragmented across unfamiliar staff.	8	Personal continuity subscale of the Nijmegen Continuity Questionnaire (Uijen et al., 2011).
Practitioner Communication (PC)	The patient's perception of how clearly, openly, and responsively providers communicate during consultations, including opportunities to ask questions.	15	Communication Assessment Tool, CAT (Makoul, Krupat, & Chang, 2007).
Perceived Empathic Care (PEC)	The patient's perception that providers understand and respond to their emotional state and personal concerns, not only their clinical symptoms.	10	Consultation and Relational Empathy Measure, CARE (Mercer, Maxwell, Heaney, & Watt, 2004).
Patient Engagement	The degree to which the patient feels actively involved in decisions and activities related to their own care, rather than a passive recipient.	13	Patient Activation Measure, PAM-13 (Hibbard, Mahoney, Stockard, & Tusler, 2005).
Patient Digital Literacy (PDL)	The patient's self-perceived ability to find, understand, and use digital health information and tools, such as patient portals or telehealth.	8	eHealth Literacy Scale, eHEALS (Norman & Skinner, 2006).
Patient Satisfaction	The patient's overall evaluation of their care experience across interpersonal, informational, and service dimensions.	18	Patient Satisfaction Questionnaire Short Form, PSQ-18 (Marshall & Hays, 1994).

3.4 Common Method Bias

Because all constructs were measured through a single self-reported survey, common method bias was a relevant concern. Procedural remedies included respondent anonymity, physical separation of predictor and outcome item blocks within the questionnaire, plain and unambiguous item wording, and an explicit statement that there were no right or wrong answers. Statistically, Harman's single-factor test was applied as a baseline check; the first unrotated factor explained 32% of total variance, below the 50 percent threshold. As a stronger diagnostic appropriate for PLS-SEM, full collinearity assessment was applied across all inner model constructs: all inner-model VIF values ranged from 1.06 to 3.02 (Section 4.1), below the 3.3 threshold, indicating common method bias was not a serious concern, following Kock (2015).

3.5 Data Analysis Technique

Data were analyzed using SmartPLS 4 in two stages, following standard PLS-SEM reporting practice. The measurement model stage assessed indicator loadings, composite reliability (rho_c), average variance extracted (AVE), and discriminant validity via the heterotrait-monotrait ratio (HTMT); before this stage, confirmatory tetrad analysis (CTA-PLS) was run to verify that each of the six constructs was correctly specified as reflective rather than formative, following the bootstrapped vanishing-tetrad test developed by Gudergan, Ringle, Wende, and Will (2008), where a non-significant tetrad confidence interval supports the reflective specification. The structural model stage assessed path coefficients and their significance via bootstrapping with 5,000 subsamples, R^2 and f^2 effect sizes, and multi-group differences via a permutation test with 10,000 permutations following measurement invariance testing (MICOM). Predictive relevance was assessed using PLSpredict (Shmueli et al., 2019), comparing PLS-SEM prediction error against a linear regression (LM) benchmark at the indicator level using 10-fold cross-validation with 10 repetitions, and complemented by the cross-validated predictive ability test (CVPAT) of Liengaard et al. (2021), extended by Sharma, Liengaard, Hair, Sarstedt, and Ringle (2023), which formally tests the model's average prediction loss against an indicator-average (IA) naive benchmark. Results are reported in Section 4.2. The interaction term for H9 was constructed using the two-stage approach recommended for reflective moderator constructs, and mediation for H8a-H8c was tested using bootstrapped indirect effects with bias-corrected confidence intervals, classified according to the typology of Zhao, Lynch, and Chen (2010) as complementary, indirect-only, or direct-only, depending on whether the corresponding direct effect (H4-H6) remained significant alongside the indirect path; because the PS × PE interaction also proved significant, conditional indirect effects and an index of moderated mediation were additionally computed following Hayes (2015), reported in Section 4.4.1. Importance-performance map analysis (IPMA; Ringle & Sarstedt, 2016) and necessary condition analysis (NCA; Dul, 2016) were both run on the final dataset as planned, following the principle that supplementary techniques should earn their place rather than be reported by default; because neither technique's output added an interpretation that the structural path coefficients, the mediation results, and the conditional indirect effects did not already provide, both were dropped from the confirmatory report, consistent with Section 4.4.1.

3.6 Research Ethics and Informed Consent

The Declaration of Helsinki guided every stage of this study's ethical conduct. The protocol, questionnaire, informed consent procedure, and data protection plan received approval from the Komite Etik Penelitian Universitas Ciputra Surabaya (KEP-UC), approval No. 073/EC/KEP-UC/IVI2026, with site-level permission from all three RSUD before recruitment began.

All respondents gave written informed consent after being informed of the study's purpose, procedures, voluntary nature, and right to withdraw without affecting their care. No identifying information was recorded; responses were linked only to a de-identified case number, with access restricted to the research team. Field staff were trained to pause or discontinue the interview if a respondent showed distress or fatigue and to refer clinical needs to on-duty hospital staff.

4. Results and Discussion

4.1 Result

4.1.1 Measurement Model Assessment

All 72 indicators across the six reflective constructs loaded above the 0.70 threshold, ranging from 0.721 (PS16) to 0.839 (PDL6), supporting indicator reliability. Table 3 reports the individual outer loading for each of the 72 indicators alongside construct-level reliability and convergent validity statistics. All six constructs exceed the 0.70 threshold for Cronbach's alpha and composite reliability (rho_a, rho_c), and all exceed the 0.50 threshold for average variance extracted (AVE), supporting convergent validity.

Table 3. Outer Loadings and Construct Reliability/Convergent Validity

Construct / Indicator	Loading	Cronbach's alpha	rho_a	rho_c	AVE
Patient Digital Literacy (PDL)		**0.926**	**0.928**	**0.939**	**0.660**

Construct / Indicator	Loading	Cronbach's alpha	rho_a	rho_c	AVE
PDL1	0.816				
PDL2	0.838				
PDL3	0.819				
PDL4	0.779				
PDL5	0.788				
PDL6	0.839				
PDL7	0.801				
PDL8	0.815				
Patient Engagement (PE)		**0.955**	**0.955**	**0.960**	**0.650**
PE1	0.800				
PE2	0.801				
PE3	0.806				
PE4	0.836				
PE5	0.810				
PE6	0.793				
PE7	0.803				
PE8	0.781				
PE9	0.805				
PE10	0.803				
PE11	0.833				
PE12	0.797				
PE13	0.815				
Patient Satisfaction (PS)		**0.957**	**0.958**	**0.961**	**0.578**
PS1	0.766				
PS2	0.775				
PS3	0.730				
PS4	0.751				
PS5	0.750				
PS6	0.763				
PS7	0.749				
PS8	0.766				
PS9	0.761				
PS10	0.771				
PS11	0.784				
PS12	0.771				
PS13	0.772				
PS14	0.755				
PS15	0.765				
PS16	0.721				
PS17	0.765				
PS18	0.762				
Perceived Care Continuity (PCC)		**0.928**	**0.929**	**0.941**	**0.665**
PCC1	0.828				
PCC2	0.806				
PCC3	0.834				
PCC4	0.800				
PCC5	0.818				
PCC6	0.831				
PCC7	0.823				

Construct / Indicator	Loading	Cronbach's alpha	rho_a	rho_c	AVE
PCC8	0.782				
Perceived Empathic Care (PEC)		**0.941**	**0.942**	**0.950**	**0.655**
PEC1	0.810				
PEC2	0.798				
PEC3	0.798				
PEC4	0.810				
PEC5	0.822				
PEC6	0.828				
PEC7	0.813				
PEC8	0.813				
PEC9	0.783				
PEC10	0.816				
Practitioner Communication (PC)		**0.949**	**0.951**	**0.955**	**0.584**
PC1	0.763				
PC2	0.745				
PC3	0.732				
PC4	0.762				
PC5	0.790				
PC6	0.768				
PC7	0.764				
PC8	0.774				
PC9	0.780				
PC10	0.756				
PC11	0.769				
PC12	0.792				
PC13	0.767				
PC14	0.734				
PC15	0.768				

Discriminant validity was assessed using the heterotrait-monotrait ratio (HTMT). All construct pairs fall below the conservative 0.85 threshold, with the highest ratio observed between Patient Engagement and Patient Satisfaction (HTMT = 0.763), still within the acceptable range. The Fornell-Larcker criterion is also satisfied: the square root of each construct's AVE exceeds its highest correlation with any other construct. All outer-model VIF values range from 1.94 to 2.93, and all inner-model VIF values range from 1.06 to 3.02, both well below the 3.3 threshold, indicating collinearity is not a concern (Table 4).

Table 4. Discriminant Validity (HTMT Matrix)

Contruct	PDL	PE	PS	PCC	PEC	PC
Patient Digital Literacy (PDL)	–					
Patient Engagement (PE)	0.661	–				
Patient Satisfaction (PS)	0.514	0.763	–			
Perceived Care Continuity (PCC)	0.381	0.452	0.509	–		
Perceived Empathic Care (PEC)	0.399	0.588	0.600	0.228	–	
Practitioner Communication (PC)	0.382	0.491	0.577	0.168	0.298	–

Confirmatory tetrad analysis (CTA-PLS) supported a reflective specification for all six constructs. Across the representative set of non-redundant vanishing tetrads reported by SmartPLS 4 for each construct (PDL: 20 tetrads; PE: 65; PS: 134; PCC: 20; PEC: 35; PC: 90), the proportion whose 95% confidence interval excluded zero without correction for multiple testing was low throughout (PDL 10.0%, PE 15.4%, PS 5.2%, PCC 5.0%, PEC 5.7%, PC 5.6%). Because testing dozens to over a hundred tetrads simultaneously inflates the Type I error rate, a Bonferroni-adjusted confidence interval was also computed for every tetrad following Gudergan et al. (2008); under this stricter criterion, 0% of tetrads excluded zero for all six constructs. A vanishing tetrad is a linear combination of covariances among four indicators that equals zero under a reflective, but not a formative, measurement model, so a confidence interval that includes zero fails to reject reflective specification while one that excludes zero flags a candidate formative indicator set. With essentially no tetrads departing from zero once corrected, the reflective specification adopted in Section 3.5 is fully supported for all six constructs, including the two multi-facet instruments (PSQ-18, CAT) flagged for scrutiny in Section 3.3.

4.1.2 Structural Model Assessment

The model explains a moderate to substantial share of variance in the two endogenous constructs: $R^2 = 0.499$ (adjusted 0.495) for Patient Engagement, and $R^2 = 0.475$ (adjusted 0.467) for Patient Digital Literacy. Model fit indices fall within acceptable ranges (SRMR = 0.050, below the 0.08 threshold; NFI = 0.872). Table 5 reports the structural path coefficients as estimated, using 5,000 bootstrap subsamples.

Out-of-sample predictive relevance was assessed using PLSpredict (Shmueli, Sarstedt, & Hair, 2019) with 10-fold cross-validation. Q^2predict was positive for both endogenous constructs (Patient Engagement = 0.489; Patient Digital Literacy = 0.269) and for every one of the 21 reflective indicators of these two constructs (range: 0.140-0.364), indicating the model possesses predictive relevance beyond chance for every indicator individually, not only at the construct level. Comparing PLS-SEM prediction error (RMSE) against the naive linear regression (LM) benchmark, all 13 Patient Engagement indicators and all 8 Patient Digital Literacy indicators showed lower PLS-SEM RMSE than the LM benchmark; following Shmueli et al. (2019), a model in which the PLS-SEM RMSE is lower than the LM RMSE for all indicators of a construct is judged to have high predictive power, which was the case for both endogenous constructs here.

This finding was corroborated by the cross-validated predictive ability test (CVPAT; Liengaard et al., 2021; Sharma et al., 2023), which formally compares the PLS-SEM model's average out-of-sample prediction loss against an indicator-average (IA) naive benchmark using a paired t-test. The PLS-SEM model significantly outperformed the IA benchmark for both endogenous constructs and overall (Table 5a): Patient Engagement (average loss difference = -0.830, $t = 9.280$, $p < .001$), Patient Digital Literacy (average loss difference = -0.463, $t = 5.715$, $p < .001$), and the overall model (average loss difference = -0.690, $t = 9.228$, $p < .001$). All 21 individual indicators showed the same pattern (all $p < .001$), providing formal, significance-tested evidence of out-of-sample predictive power beyond what Q^2predict and PLSpredict RMSE comparisons alone provide.

Table 5. PLSpredict and CVPAT Results: Construct-Level Predictive Relevance

Construct	Q^2predict	PLS-SEM RMSE	PLS-SEM MAE	CVPAT: PLS loss	CVPAT: IA loss	Loss difference	t	p
Patient Engagement (PE)	0.489	0.718	0.578	1.794	2.624	-0.830	9.280	<.001

Patient Digital Literacy (PDL)	0.269	0.859	0.698	2.160	2.623	-0.463	5.715	<.001
Overall	—	—	—	1.933	2.624	-0.690	9.228	<.001

Table 6. Structural Path Coefficients (Bootstrapped, N = 5,000 subsamples)

Path	β	t	p	f^2	Result
Perceived Care Continuity (PCC) → Patient Engagement (PE)	0.290	8.359	<.001	0.159	Significant
Perceived Empathic Care (PEC) → Patient Engagement (PE)	0.410	11.117	<.001	0.299	Significant
Practitioner Communication (PC) → Patient Engagement (PE)	0.310	8.564	<.001	0.174	Significant
Patient Engagement (PE) → Patient Digital Literacy (PDL)	0.531	9.874	<.001	0.223	Significant
Patient Satisfaction (PS) → Patient Digital Literacy (PDL)	-0.049	0.696	.487	0.002	Not significant
Patient Satisfaction (PS) × Patient Engagement (PE) → Patient Digital Literacy (PDL) (interaction)	0.238	7.970	<.001	0.129	Significant
Perceived Care Continuity (PCC) → Patient Digital Literacy (PDL)	0.110	2.549	.011	0.017	Significant
Practitioner Communication (PC) → Patient Digital Literacy (PDL)	0.111	2.380	.017	0.016	Significant
Perceived Empathic Care (PEC) → Patient Digital Literacy (PDL)	0.046	0.933	.351	0.002	Not significant

Perceived Care Continuity, Perceived Empathic Care, and Practitioner Communication each significantly predict Patient Engagement, with Perceived Empathic Care carrying the largest effect (f^2 = 0.299, a large effect by Cohen's convention) followed by Practitioner Communication and Perceived Care Continuity (both medium effects). Patient Engagement significantly predicts Patient Digital Literacy with a medium-to-large effect. Perceived Care Continuity and Practitioner Communication retain small but significant direct effects on Patient Digital Literacy; Perceived Empathic Care does not. Patient Satisfaction alone does not significantly predict Patient Digital Literacy, but the PS × PE interaction term does, at a medium effect size, indicating a significant moderation effect.

4.1.3 Mediation via Patient Engagement

Bootstrapped specific indirect effects confirm that Patient Engagement carries a significant portion of the effect of all three relational care quality constructs onto Patient Digital Literacy (Table 6). Because PCC and PC also retain significant direct effects on PDL (Table 5), both relationships show complementary (partial) mediation, with Patient Engagement accounting for 58.3% and 59.8% of their respective total effects (variance accounted for, VAF). Because PEC's direct effect on PDL is not significant while its indirect effect through PE is, the PEC-PDL relationship shows indirect-only (full) mediation, following the typology of Zhao, Lynch, and Chen (2010).

Table 7. Mediation (Indirect Effect) Test Results

Path	Indirect β	t	p	95% CI	Direct β (p)	VAF	Mediation type
PCC → PE → PDL	0.154	6.168	<.001	[0.108, 0.206]	0.110 (.011)	58.3%	Complementary (partial)
PEC → PE → PDL	0.218	7.246	<.001	[0.163, 0.279]	0.046 (.351)	82.6%	Indirect-only (full)

PC → PE → PDL	0.165	6.419	<.001	[0.117, 0.216]	0.111 (.017)	59.8%	Complementary (partial)

4.1.4 Moderation Effect

The interaction term PS × PE was constructed using the two-stage approach and entered directly into the structural model reported in Table 5. Table 7 isolates this moderation test, and simple slope analysis clarifies its form by reporting the conditional effect of Patient Engagement on Patient Digital Literacy at low, mean, and high levels of Patient Satisfaction. The effect of Patient Engagement on Patient Digital Literacy is substantially stronger among cases with higher Patient Satisfaction, indicating that Patient Satisfaction positively moderates, and in this data amplifies, the engagement-to-digital-literacy relationship. The three specific indirect effects reported in Section 4.3 follow the same conditional pattern, roughly doubling to nearly tripling in magnitude from -1 SD to +1 SD of Patient Satisfaction; Section 4.4.1 reports the full conditional indirect effects and the index of moderated mediation for all three paths (Table 8).

Table 8. Moderation Test Results

A.Interaction Effect

Interaction term	β	t	p	f^2	Result
PS × PE → PDL	0.238	7.970	<.001	0.129 (medium)	Significant moderation

B. Simple Slope Analysis: Conditional Effect of PE → PDL at Levels of PS

Level of Patient Satisfaction (PS)	Conditional effect (PE → PDL)
-1 SD (low PS)	0.293
Mean PS	0.531
+1 SD (high PS)	0.769

4.1.5 Conditional Indirect Effects and the Index of Moderated Mediation

Because Patient Satisfaction significantly moderates the second stage of the PCC/PEC/PC → PE → PDL chain (Table 7), the indirect effects reported in Table 6 are themselves conditional on the level of Patient Satisfaction rather than constant across patients. Table 8 reports the specific indirect effect of each relational care quality construct on Patient Digital Literacy, through Patient Engagement, at −1 SD, the mean, and +1 SD of Patient Satisfaction, together with the index of moderated mediation for each path, computed as the product of the corresponding a-path coefficient (Table 5) and the PS × PE interaction coefficient (β = 0.238), following Hayes (2015).

Table 9. Conditional Indirect Effects and Index of Moderated Mediation

Path	Indirect effect at −1 SD PS	Indirect effect at Mean PS	Indirect effect at +1 SD PS	Index of moderated mediation
PCC → PE → PDL	0.085	0.154	0.223	0.069
PEC → PE → PDL	0.120	0.218	0.315	0.098
PC → PE → PDL	0.091	0.165	0.238	0.074

The pattern is consistent across all three relational care quality constructs: the indirect effect of PCC, PEC, and PC on Patient Digital Literacy through Patient Engagement roughly doubles to nearly triples in magnitude between low and high Patient Satisfaction, with the largest conditional indirect effect for Perceived Empathic Care (0.315 at +1 SD, versus 0.120 at −1 SD). Because the a-path for every relational care quality construct is significant and positive (Table 5) and the PS × PE interaction is significant and positive (Table 7), the index of moderated mediation is interpreted as substantively meaningful for all three paths, consistent with H9 operating as a boundary condition on the entire mediated chain rather than on the PE → PDL link in isolation. A bootstrapped confidence interval around the index itself was not separately generated by the analysis software used here; the interpretation above rests on the significance of the component paths rather than a directly bootstrapped index, and this distinction is noted as a methodological limitation in Section 7.

Consistent with the decision rule specified in Section 3.5, importance-performance map analysis (IPMA) and necessary condition analysis (NCA) were evaluated on the final dataset and judged not to add interpretation beyond the structural path coefficients (Table 5), the mediation results (Table 6), and the conditional indirect effects above (Table 8). Both techniques are therefore omitted from the confirmatory results reported here; full IPMA and NCA output is available from the corresponding author on request.

4.1.6 Multi-Group Analysis Across Hospital Sites: MICOM and MGA Results

Because the multi-site design was intended to support a structural comparison across the three RSUD, measurement invariance was established before any path coefficient was compared between sites, following the three-step MICOM procedure (configural invariance, compositional invariance, and equality of composite means and variances) of Henseler, Ringle, and Sarstedt (2016). Configural invariance (Step 1) was satisfied by design, since the same indicators, algorithm settings, and estimation procedure were applied identically across all three sites. Compositional invariance (Step 2) was supported for all six constructs in all three pairwise comparisons (RSUD Haji Makassar vs. RSUD Kota Makassar, RSUD Haji Makassar vs. RSUD Labuang Baji, and RSUD Kota Makassar vs. RSUD Labuang Baji), with permutation p-values for the correlation between composite scores ranging from .186 to .952 across all pairs, none falling below the .05 threshold. This satisfies the minimum condition under Henseler et al. (2016) for proceeding to a multi-group comparison of structural path coefficients for every construct.

Step 3 (equality of means and variances) produced full invariance for two of the three pairs. RSUD Haji Makassar and RSUD Kota Makassar showed no significant difference in composite means (all $p > .10$) or variances (all $p > .05$) across all six constructs, supporting full measurement invariance and unrestricted pooling or comparison for this pair. RSUD Kota Makassar and RSUD Labuang Baji likewise showed full invariance, with all mean and variance comparisons non-significant ($p = .100$-$.833$ for means; $p = .170$-$.979$ for variances). RSUD Haji Makassar and RSUD Labuang Baji, by contrast, achieved only partial invariance: composite means did not differ significantly for any construct, but composite variances differed significantly for Patient Digital Literacy ($p = .002$) and Practitioner Communication ($p = .013$). Following Henseler et al. (2016), partial invariance is sufficient to proceed with a multi-group comparison of structural path coefficients for this pair, but composite mean scores between RSUD Haji Makassar and RSUD Labuang Baji should not be compared directly for Patient Digital Literacy or Practitioner Communication.

Table 9 reports the multi-group comparison of structural path coefficients across all three pairs, using a permutation test (10,000 permutations) as the primary significance test, following Henseler et al. (2016), and cross-checked against a parametric test (Sarstedt, Henseler, & Ringle, 2011) for the two pairs involving RSUD Haji Makassar. RSUD Haji Makassar and RSUD Kota Makassar did not differ significantly on any structural path (all permutation $p > .10$), indicating the hypothesized model held consistently across these two sites. RSUD Labuang Baji, however, differed significantly from both other sites on two paths.

The direct effect of Patient Satisfaction on Patient Digital Literacy was significantly stronger and reversed in sign at RSUD Labuang Baji (β = -0.311) compared with RSUD Haji Makassar (β = 0.136, permutation p = .002) and RSUD Kota Makassar (β = 0.126, permutation p = .015); the parametric test corroborated this difference for the Haji Makassar comparison (p = .004). The direct effect of Perceived Empathic Care on Patient Digital Literacy was likewise significantly different at RSUD Labuang Baji (β = 0.217) relative to RSUD Haji Makassar (β = -0.008, permutation p = .047) and RSUD Kota Makassar (β = -0.094, permutation p = .009). The path from Patient Engagement to Patient Digital Literacy was also significantly stronger at RSUD Labuang Baji (β = 0.671) than at RSUD Haji Makassar (β = 0.373, permutation p = .025), though this difference was not significant relative to RSUD Kota Makassar (β = 0.504, p = .207). No other structural path, including the PS × PE interaction term itself, differed significantly across any pair of sites (all p > .10), and none of the three specific indirect effects (PCC/PEC/PC → PE → PDL) differed significantly across sites (all p > .09).

Table 10. MICOM Results Across the Three Hospital Site Pairs

Comparison / Construct	Compositional invariance (p)	Equal means (p)	Equal variances (p)	Invariance status
Haji Makassar vs. Kota Makassar	.283-.952	.100-.833	.054-.974	Full
Haji Makassar vs. Labuang Baji	.186-.881	.127-.895	PDL = .002*, PC = .013*, others ns	Partial
Kota Makassar vs. Labuang Baji	.283-.845	.100-.833	.170-.979	Full

Table 11. Multi-Group Analysis: Structural Path Differences Across Hospital Site Pairs (Permutation Test)

Structural path	Δ Haji-Kota (p)	Δ Haji-Labuang Baji (p)	Δ Kota-Labuang Baji (p)
PE → PDL	-0.131 (.329)	-0.298 (.025)*	-0.167 (.207)
PS → PDL	0.010 (.958)	0.446 (.002)*	0.436 (.015)*
PS × PE → PDL	-0.008 (.928)	-0.003 (.979)	0.006 (.953)
PCC → PDL	-0.018 (.858)	0.127 (.205)	0.146 (.198)
PCC → PE	0.033 (.719)	-0.068 (.443)	-0.102 (.235)
PEC → PDL	0.087 (.468)	-0.225 (.047)*	-0.312 (.009)*
PEC → PE	0.038 (.693)	0.032 (.716)	-0.005 (.951)
PC → PDL	-0.044 (.717)	-0.032 (.797)	0.013 (.925)
PC → PE	-0.027 (.754)	-0.105 (.246)	-0.078 (.373)

*p < .05. Values are the original difference in path coefficients between the first-named and second-named site, with the permutation p-value in parentheses.

Substantively, RSUD Labuang Baji stands apart from the other two sites on precisely the paths that carry the study's theoretical weight. At RSUD Labuang Baji, Patient Satisfaction predicts Patient Digital Literacy directly and negatively, Perceived Empathic Care predicts it directly and positively, and Patient Engagement carries an unusually strong direct effect, whereas at RSUD Haji Makassar and RSUD Kota Makassar these same paths are weak or null. RSUD Haji Makassar and RSUD Kota Makassar, in turn, are statistically indistinguishable from one another on every structural path tested. This pattern is discussed as a site-level boundary condition in Section 5.6, rather than treated as sampling noise, because it recurs consistently across two independent comparisons (Haji-Labuang Baji and Kota-Labuang Baji) that both isolate the same site and the same two paths.

4.2 Discussion

4.2.1 Relational Care Quality as an Antecedent of Patient Engagement

Perceived Care Continuity, Practitioner Communication, and Perceived Empathic Care each significantly predicted Patient Engagement, jointly explaining just under half of its variance ($R^2 = 0.499$). Perceived Empathic Care carried the largest effect ($f^2 = 0.299$, large), ahead of Practitioner Communication and Perceived Care Continuity (both medium). This ordering is consistent with Mei, Xu, and Li (2020), who found empathic, functional-quality behaviors were the strongest touchpoint driving patient trust and engagement in a Chinese public hospital sample, and with Cha (2025), who found communication and shared decision-making were among the strongest correlates of active patient participation in the 2023 Korea Healthcare Service Experience Survey. The convergence across an Indonesian regional-hospital estimate, a Chinese hospital sample, and a Korean national survey suggests the empathy-to-engagement pathway is not a culturally narrow finding, though the site-level heterogeneity reported in Section 4.5 and discussed in Section 5.6 indicates this ordering is not perfectly uniform across all three RSUD.

4.2.2 Patient Engagement as an Antecedent of Digital Literacy

The central structural result is that Patient Engagement significantly predicted Patient Digital Literacy ($\beta = 0.531$, the largest single path coefficient in the model), explaining 47.5% of its variance. This direction, engagement predicting digital literacy rather than the conventional framing of digital literacy predicting engagement, has direct empirical precedent. Bonifanti, Ko, and Ownby (2025) found eHealth literacy was significantly related to patient activation after controlling for sociodemographic factors in a chronic-disease RCT sample, and explicitly noted the relationship may run in either direction: activated patients may seek out and build digital skills as an extension of their engagement, just as digital skills may enable activation. Shiu, Huang, Liu, Cheng, and Chen (2025) similarly found that relationally-driven constructs (social support) fed into eHealth literacy, which then drove technology acceptance, in a chronic-illness sample in Taiwan, supporting a pathway in which relational and motivational factors convert into digital capability rather than the reverse. Read together with the present model's PCC/PC/PEC → PE → PDL chain, this suggests a plausible developmental account: patients who feel engaged in their care are more motivated to seek out, practice with, and become competent in digital health tools, rather than digital competence being a fixed trait patients bring into the relationship.

4.2.3 Direct Effects of Relational Care Quality on Digital Literacy

Perceived Care Continuity and Practitioner Communication retained small but significant direct effects on Patient Digital Literacy alongside their indirect effects through Patient Engagement, consistent with continuity of provider relationships and clear communication translating partly into confidence navigating digital health tools even without full engagement. Perceived Empathic Care's direct effect on Patient Digital Literacy was not significant, meaning its influence operates only through Patient Engagement; this is consistent with Deshpande, Arora, Vollbrecht, Meltzer, and Press (2023), who found eHealth literacy was associated with patient portal awareness and use largely independent of the emotional register of the clinical encounter, suggesting empathy shapes digital behavior indirectly, by building the motivational state of engagement, rather than by directly building digital skill.

4.2.4 Patient Satisfaction as a Moderator of the Engagement-Digital Literacy Link

Patient Satisfaction alone did not significantly predict Patient Digital Literacy ($\beta = -0.049$, $p = .487$), but its interaction with Patient Engagement did ($\beta = 0.238$, $p < .001$, medium effect), and simple slope analysis showed the engagement-to-digital-literacy effect nearly tripling from $\beta = 0.293$ among less-satisfied cases to $\beta = 0.769$ among more-satisfied cases. In other words, engagement alone does not reliably build digital literacy; it does so mainly among patients who are also satisfied with their care. This mirrors the logic in Peimani, Stewart, Ghodssi-Ghassemabadi, Nasli-Esfahani, and Ostovar (2024), who found e-health literacy significantly moderated the relationship between online information-seeking and self-care behavior among patients with type 2 diabetes, strengthening the effect for more digitally literate patients; here the roles are reversed, with satisfaction moderating rather than being moderated, but the underlying mechanism is structurally similar, a favorable psychological or relational state amplifies how effectively patients convert one capability (engagement, information-seeking) into another (digital literacy, self-care). A plausible account is that dissatisfaction narrows patients' attention to the immediate service problem, crowding out the exploratory behavior needed to build digital competence, while satisfaction frees up cognitive and motivational resources for that exploration.

4.2.5 Mediation Pathways

The mediation pattern reported in Table 6 differentiates the three relational care quality constructs meaningfully. Perceived Care Continuity and Practitioner Communication show complementary (partial) mediation, meaning part of their effect on Patient Digital Literacy operates directly and part through Patient Engagement (VAF 58.3% and 59.8% respectively). Perceived Empathic Care shows indirect-only (full) mediation (VAF 82.6% relative to a non-significant direct effect), meaning essentially its entire influence on Patient Digital Literacy is routed through Patient Engagement. Practically, this distinction matters: interventions that build continuity or communication can be expected to move digital literacy somewhat even without moving engagement, while empathy-focused interventions will only translate into digital literacy gains if they first succeed in raising engagement.

4.2.6 Site-Level Heterogeneity Across Hospitals

The multi-group analysis (Section 4.5) adds a boundary condition the pooled results alone do not reveal. RSUD Haji Makassar and RSUD Kota Makassar were statistically indistinguishable on every structural path, but RSUD Labuang Baji differed significantly from both on the direct effect of Patient Satisfaction on Patient Digital Literacy, the direct effect of Perceived Empathic Care on Patient Digital Literacy, and, relative to RSUD Haji Makassar, the strength of the Patient Engagement → Patient Digital Literacy path. At RSUD Labuang Baji, Patient Satisfaction predicted Patient Digital Literacy directly and negatively ($\beta = -0.311$); at the other two sites this direct path was weak, positive, and non-significant. Perceived Empathic Care predicted Patient Digital Literacy directly and positively only at RSUD Labuang Baji ($\beta = 0.217$); at RSUD Haji Makassar and RSUD Kota Makassar this direct path was near zero or negative.

One plausible reading is that RSUD Labuang Baji's patient population, service environment, or digital infrastructure differs enough from the other two sites that patients there convert empathic care and engagement into digital literacy through a somewhat different route, one in which emotional rapport with providers substitutes more directly for the satisfaction-dependent engagement pathway that dominates at the other two hospitals. This would be consistent with the boundary-condition logic proposed in Section 2.8 for Patient Satisfaction, extended one level further: not only does satisfaction condition whether engagement converts into digital literacy, but the institutional context itself conditions which relational quality construct does the converting. Because this pattern recurs independently in two separate pairwise comparisons that both isolate RSUD Labuang Baji, it is treated here as a genuine site-level finding rather than a single anomalous comparison, though the explanation offered is necessarily post hoc and would benefit from a follow-up study designed specifically to test site-level moderators such as patient case-mix, average waiting time, or digital infrastructure maturity.

5. Implications

5.1 Theoretical Implications

A small but growing literature has debated the direction of the link between patient engagement and digital health literacy, and the present findings speak directly to that question. Where eHealth literacy is conventionally modeled as an antecedent condition patients bring into a digital encounter (e.g., Norman & Skinner, 2006; Peimani et al., 2024), the results here, read alongside Bonifanti et al. (2025) and Shiu et al. (2025), are consistent with a developmental account in which relational care quality builds engagement, and engagement in turn builds digital literacy over the course of the care relationship. The study also extends the moderation literature on digital health literacy: rather than testing digital literacy as the moderating condition (the more common specification, e.g., Peimani et al., 2024), it tests patient satisfaction as a moderator of the engagement-to-digital-literacy path, suggesting satisfaction functions as a psychological precondition that determines whether engagement converts into digital capability.

5.2 Practical Implications

For RSUD management, three implications follow. First, because Perceived Empathic Care shows the strongest total effect on Patient Engagement and operates entirely through it, empathy-focused staff training is likely the highest-leverage single investment for building both engagement and, indirectly, digital literacy. Second, because Patient Satisfaction moderates rather than directly drives digital literacy gains, hospitals rolling out digital tools such as patient portals or telehealth should not expect engagement programs to build digital competence on their own among dissatisfied patients; service-quality issues driving dissatisfaction should be resolved before or alongside digital literacy initiatives, not after. Third, because Perceived Care Continuity and Practitioner Communication retain direct effects on digital literacy independent of engagement, scheduling patients with a consistent provider team and training staff in clear communication are likely to yield some digital literacy gains even for patients who do not otherwise engage deeply with their care.

6. Limitations and Future Research

The cross-sectional design limits causal inference; a longitudinal follow-up could confirm whether engagement gains precede digital literacy gains rather than the reverse, a question the discussion in Section 5.2 could only address indirectly through cross-sectional precedent. Reliance on self-reported measures across all constructs, despite the procedural and statistical remedies described in Section 3.4, cannot fully rule out common method bias; future studies could pair patient-reported engagement with objective indicators such as portal login frequency or telehealth session counts as a behavioral proxy for digital literacy. Restricting the sample to three RSUD in one Indonesian city limits generalizability to other hospital classifications or regions; future multi-group studies could compare Type A, B, and C hospitals or urban and rural facilities to test whether the moderating role of patient satisfaction holds across contexts with different baseline digital infrastructure. The multi-group analysis reported in Section 4.5 found that RSUD Haji Makassar and RSUD Kota Makassar achieved full measurement invariance, but RSUD Haji Makassar and RSUD Labuang Baji achieved only partial invariance, with composite variances differing significantly for Patient Digital Literacy and Practitioner Communication; composite mean scores should therefore not be compared directly between these two sites, even though the structural path comparison itself remained valid under partial invariance following Henseler et al. (2016). The unidimensionality assumed for the Patient Satisfaction and Practitioner Communication instruments (Section 3.3) was supported empirically by the confirmatory tetrad analysis on the realized sample (Section 4.1), but this check was performed at the pooled, whole-sample level rather than separately within each hospital site, so site-specific dimensionality cannot be ruled out. The index of moderated mediation reported in Section 4.4.1 was derived from the significance of its component coefficients rather than from a directly bootstrapped confidence interval around the index itself, and future analyses with software that supports this feature should confirm it formally. Finally, half of the realized sample (200 of 400 respondents, 50.0%) completed the questionnaire with a caregiver reading items aloud or recording the patient's verbal responses rather than self-administering the instrument; while the protocol in Section 3.2 restricted caregivers to this reading/recording role and prohibited independent rating, a reading-assisted mode of administration cannot be assumed equivalent to fully independent self-report, and social-desirability or acquiescence effects in the presence of a caregiver cannot be ruled out. Because this affected half the sample rather than a small subset, we recommend a sensitivity check, not performed here, comparing key path coefficients between the caregiver-assisted and fully independent subsamples before the finding is generalized without qualification.

7. Conclusion

Relational care quality, operationalized here as perceived care continuity, practitioner communication, and perceived empathic care, was tested for its direct and indirect influence on a downstream patient outcome through patient engagement, and for whether that indirect path depended on a second patient-level factor. The model tested on N = 400 patients across three RSUD in Makassar answers this question with Patient Digital Literacy as the downstream outcome and Patient Satisfaction as the conditioning factor: all three relational care quality constructs significantly predicted Patient Engagement, which in turn significantly predicted Patient Digital Literacy; Perceived Care Continuity and Practitioner Communication retained additional direct effects on Patient Digital Literacy while Perceived Empathic Care's influence operated entirely through engagement; and Patient Satisfaction, though not a significant direct predictor on its own, significantly and substantially strengthened the engagement-to-digital-literacy relationship, nearly tripling in magnitude between less-satisfied and more-satisfied cases. The multi-group analysis further showed this structure held consistently at RSUD Haji Makassar and RSUD Kota Makassar, while RSUD Labuang Baji departed from both on the role of Patient Satisfaction and Perceived Empathic Care (Section 4.5, 5.6).

Substantively, the pattern supports a developmental account in which relational care quality builds patient engagement, and engagement converts into digital health literacy most readily among patients who are also satisfied with their care, a conditional pathway not previously tested in a single moderated-mediation model in the literature reviewed in Section 5. Methodologically, the measurement model met all conventional PLS-SEM thresholds for reliability, convergent validity, discriminant validity, and reflective specification (Section 4.1), giving confidence that the constructs were well measured on the realized N = 400 sample collected across the three RSUD sites.

These conclusions rest on N = 400 patients across three Type B RSUD in Makassar and should be read within that scope. The multi-group analysis (Section 4.5) showed the core structural model held consistently at two of the three sites, RSUD Haji Makassar and RSUD Kota Makassar, while RSUD Labuang Baji diverged on the role of Patient Satisfaction and Perceived Empathic Care; this site-level heterogeneity, discussed in Section 5.6, qualifies the generalizability of the pooled estimates rather than undermining them, since the pooled model and the site-specific pattern are consistent with one another once the partial measurement invariance reported in Section 4.5 is taken into account. As with any cross-sectional, self-reported design, the directional claims about engagement building digital literacy remain an inference from a developmental theoretical account rather than a demonstration of temporal precedence; the limitations and future-research directions in Section 7 outline how a longitudinal or behavioral-proxy design could strengthen this claim in subsequent work.

References

Alharbi, K., Almutairi, H. A., & Albagami, N. S. (2026). Exploring the patient engagement in the healthcare decision-making process and its association with patients' satisfaction. Nursing Open, 13(4), e70501. https://doi.org/10.1002/nop2.70501

Bonifanti, L., Ko, C., & Ownby, R. L. (2025). The role of electronic health (eHealth) literacy in patient activation: A sequential block regression analysis controlling for sociodemographic factors. Cureus, 17(11), e97646. https://doi.org/10.7759/cureus.97646

Cha, Y.-J. (2025). Key factors influencing outpatient satisfaction in chronic disease care: Insights from the 2023 Korea HSES. Healthcare, 13(6), 655. https://doi.org/10.3390/healthcare13060655

Chen, C.-C., & Cheng, S.-H. (2023). Does continuity of care improve patient satisfaction? An instrumental variable approach. Health Policy, 130, 104754. https://doi.org/10.1016/j.healthpol.2023.104754

Deshpande, N., Arora, V. M., Vollbrecht, H., Meltzer, D. O., & Press, V. (2023). eHealth literacy and patient portal use and attitudes: Cross-sectional observational study. JMIR Human Factors, 10, e40105. https://doi.org/10.2196/40105

Dul, J. (2016). Necessary condition analysis (NCA): Logic and methodology of 'necessary but not sufficient' causality. Organizational Research Methods, 19(1), 10-52. https://doi.org/10.1177/1094428115584005

Dul, J., Van der Laan, E., & Kuik, R. (2020). A statistical significance test for necessary condition analysis. Organizational Research Methods, 23(2), 385-395. https://doi.org/10.1177/1094428118795272

Gudergan, S. P., Ringle, C. M., Wende, S., & Will, A. (2008). Confirmatory tetrad analysis in PLS path modeling. Journal of Business Research, 61(12), 1238-1249. https://doi.org/10.1016/j.jbusres.2008.01.012

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). A primer on partial least squares structural equation modeling (PLS-SEM) (3rd ed.). Sage Publications.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2016). Testing measurement invariance of composites using partial least squares. International Marketing Review, 33(3), 405-431. https://doi.org/10.1108/IMR-09-2014-0304

Hibbard, J. H., Mahoney, E. R., Stockard, J., & Tusler, M. (2005). Development and testing of a short form of the Patient Activation Measure. Health Services Research, 40(6 Pt 1), 1918-1930. https://doi.org/10.1111/j.1475-6773.2005.00438.x

Keelson, S. A., Addo, J. O., & Amoah, J. (2024). The impact of patient engagement on service quality and customer well-being: An introspective analysis from the healthcare providers' perspective. Cogent Public Health, 11(1), 2340157. https://doi.org/10.1080/27707571.2024.2340157

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. International Journal of e-Collaboration, 11(4), 1-10. https://doi.org/10.4018/ijec.2015100101

Liengaard, B. D., Sharma, P. N., Hult, G. T. M., Jensen, M. B., Sarstedt, M., Hair, J. F., & Ringle, C. M. (2021). Prediction: Coveted, yet forsaken? Introducing a cross-validated predictive ability test in partial least squares path modeling. Decision Sciences, 52(2), 362-392. https://doi.org/10.1111/deci.12445

Makoul, G., Krupat, E., & Chang, C. H. (2007). Measuring patient views of physician communication skills: Development and testing of the Communication Assessment Tool. Patient Education and Counseling, 67(3), 333-342. https://doi.org/10.1016/j.pec.2007.05.005

Marshall, G. N., & Hays, R. D. (1994). The Patient Satisfaction Questionnaire Short-Form (PSQ-18). RAND Corporation, P-7865. https://www.rand.org/pubs/papers/P7865.html

Marzban, S., Najafi, M., Agolli, A., & Ashrafi, E. (2022). Impact of patient engagement on healthcare quality: A scoping review. Journal of Patient Experience, 9, 23743735221125439. https://doi.org/10.1177/23743735221125439

Mei, Y., Xu, X., & Li, X. (2020). Encouraging patient engagement behaviors from the perspective of functional quality. International Journal of Environmental Research and Public Health, 17(22), 8613. https://doi.org/10.3390/ijerph17228613

Mercer, S. W., Maxwell, M., Heaney, D., & Watt, G. C. M. (2004). The consultation and relational empathy (CARE) measure: Development and preliminary validation and reliability of an empathy-based consultation process measure. Family Practice, 21(6), 699-705. https://doi.org/10.1093/fampra/cmh621

Norman, C. D., & Skinner, H. A. (2006). eHEALS: The eHealth Literacy Scale. Journal of Medical Internet Research, 8(4), e27. https://doi.org/10.2196/jmir.8.4.e27

Peimani, M., Stewart, A. L., Ghodssi-Ghassemabadi, R., Nasli-Esfahani, E., & Ostovar, A. (2024). The moderating role of e-health literacy and patient-physician communication in the relationship between online diabetes information-seeking behavior and self-care practices among individuals with type 2 diabetes. BMC Primary Care, 25(1), 442. https://doi.org/10.1186/s12875-024-02695-9

Ringle, C. M., & Sarstedt, M. (2016). Gain more insight from your PLS-SEM results: The importance-performance map analysis. Industrial Management & Data Systems, 116(9), 1865-1886. https://doi.org/10.1108/IMDS-10-2015-0449

Sharma, P. N., Liengaard, B. D., Hair, J. F., Sarstedt, M., & Ringle, C. M. (2023). Predictive model assessment and selection in composite-based modeling using PLS-SEM: Extensions and guidelines for using CVPAT. European Journal of Marketing, 57(6), 1662-1677. https://doi.org/10.1108/EJM-08-2020-0636

Shmueli, G., Sarstedt, M., & Hair, J. F. (2019). Predictive model assessment in PLS-SEM: Guidelines for using PLSpredict. European Journal of Marketing, 53(11), 2322-2347. https://doi.org/10.1108/EJM-02-2019-0189

Shiu, L.-S., Huang, Y.-S., Liu, C. Y., Cheng, Y.-S., & Chen, Y.-C. (2025). eHealth literacy mediating social support and technology acceptance among patients with chronic illnesses: A cross-sectional study. Journal of Advanced Nursing, 82(5), 5049-5059. https://doi.org/10.1111/jan.70207

Uijen, A. A., Schellevis, F. G., van den Bosch, W. J. H. M., Mokkink, H. G. A., van Weel, C., & Schers, H. J. (2011). Nijmegen Continuity Questionnaire: Development and testing of a questionnaire that measures continuity of care. Journal of Clinical Epidemiology, 64(12), 1391-1399. https://doi.org/10.1016/j.jclinepi.2011.03.006

Zhao, X., Lynch, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. Journal of Consumer Research, 37(2), 197-206. https://doi.org/10.1086/651257