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Structured Education and Pediatric Nurses' Perceptions and Perceived Readiness for Virtual Post-Discharge Nursing Clinics in Madinah: A Nonrandomized Pretest-Posttest Study

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Abstract

Virtual post-discharge nursing may extend continuity, caregiver education, and selected follow-up beyond pediatric hospitalization, but implementation depends partly on whether nurses view the model favorably and feel prepared to participate. Evidence on educational preparation for pediatric virtual follow-up remains limited in Saudi Arabia. This article examined whether a structured educational module was associated with changes in pediatric nurses' perceptions and perceived readiness for virtual post-discharge nursing clinics. A quantitative, nonrandomized quasi-experimental pretest-posttest design was used in selected hospitals in Madinah, Saudi Arabia. The accessible population was approximately 225 pediatric nurses; 144 were purposively recruited and allocated by hospital setting to an intervention group (n = 72) or comparison group (n = 72). Participants completed adapted 10-item perception and 10-item perceived-readiness scales before and after the intervention. The intervention group received one standardized 20-minute web-based module. Data were analyzed in SPSS using descriptive statistics, Cronbach's alpha, Wilcoxon signed-rank tests, and Mann-Whitney U tests of change scores. Within the intervention group, perceptions ($Z = -2.850$, $p = .004$, $r = .34$) and perceived readiness ($Z = -2.950$, $p = .003$, $r = .35$) changed significantly. Change also differed between groups for perceptions ($U = 2047.000$, $Z = -2.180$, $p = .029$, $r = .18$) and perceived readiness ($U = 2412.000$, $Z = -2.050$, $p = .040$, $r = .17$). The findings support modest intervention-related improvement in two self-reported workforce outcomes, not demonstrated competence or definitive causation. Structured education may therefore be one component of broader organizational and competency-based preparation for pediatric virtual follow-up.

Key Words: Pediatric Nursing, Virtual Post-Discharge Care, Educational Intervention, Perceived Readiness, Telehealth, Saudi Arabia.

1. Introduction

The transition from hospital to home is a consequential period in pediatric care. Children may continue to require medication management, symptom monitoring, treatment adherence, and timely follow-up, while parents or other caregivers assume primary responsibility for carrying out recommendations outside the clinical environment. When discharge education, communication, or coordination is incomplete, caregivers may experience uncertainty and may have difficulty recognizing changes that require professional attention. Research in Saudi pediatric settings has accordingly emphasized caregiver readiness as an important element of discharge quality (Alzahrani & Alharbi, 2024). International work likewise identifies continuity as a central concern for children whose healthcare needs continue after hospitalization (Sulino et al., 2021).

Pediatric nurses occupy a particularly relevant position in this transition. Their established responsibilities include preparing families for discharge, reinforcing instructions, explaining medication and monitoring requirements, communicating with caregivers, coordinating services, and identifying concerns that require escalation. Qualitative evidence indicates that nurses view post-discharge follow-up as an extension of continuity rather than an isolated administrative task (Handiyani et al., 2024). Yet conventional follow-up can be constrained by travel, appointment availability, time, staffing, and the difficulty of returning families to hospital for questions that may be addressed remotely.

Telehealth creates a possible channel for selected post-discharge nursing activities. Nurse-led virtual follow-up may support communication, education, symptom review, and timely referral when remote contact is clinically appropriate. A systematic review of pediatric pain follow-up found that nurse-led telehealth has been used to manage post-discharge needs, although the evidence base remains heterogeneous (Forster et al., 2023). Virtual care should not be treated as a universal substitute for physical examination; its value depends on patient selection, caregiver participation, secure technology, documentation, professional boundaries, and clear escalation pathways.

The availability of a technological platform is also insufficient by itself. Nurses must judge virtual post-discharge care to be useful and appropriate, and they must feel prepared to communicate remotely, use telehealth tools, interpret caregiver-reported information, and recognize the limits of remote assessment. Perception and perceived readiness are related but distinct. A nurse may consider virtual follow-up valuable while lacking confidence in delivering it. Conversely, familiarity with digital tools does not necessarily resolve clinical or professional concerns. Studies of nurses in different settings have documented variation in telehealth attitudes, exposure, confidence, and readiness (Guo et al., 2023). Saudi research similarly suggests that workforce readiness does not automatically accompany system-level digital expansion (Moussa et al., 2023).

Education is one potentially modifiable component of workforce preparation. Telehealth education can clarify clinical applications, professional roles, communication requirements, privacy obligations, and the point at which virtual contact should transition to face-to-face assessment. Reviews of health-professional curricula identify structured preparation as necessary for responsible telehealth practice (Chike-Harris et al., 2021). Pretest-posttest evidence has also associated tailored education with greater knowledge and self-efficacy among nurses, while showing that transfer into actual use may vary by practice setting (van Houwelingen et al., 2021). However, evidence focused simultaneously on pediatric nursing, post-discharge care, and the Saudi context remains sparse.

This gap is important in Madinah, where national digital-health development creates an enabling policy environment but does not establish local pediatric nursing preparedness. The present article draws on a broader study of pediatric nurses' perceptions and perceived readiness regarding virtual post-discharge nursing clinics. It focuses specifically on the structured educational intervention and treats perception and perceived readiness as parallel self-reported outcomes. The objective was to examine within-intervention-group change and whether change differed from that observed in a comparison group. The article contributes theoretically by applying the Technology Acceptance Model (TAM) as an interpretive lens without claiming to test its complete causal structure. It contributes practically by providing local evidence relevant to educational planning while explicitly distinguishing perceived readiness from demonstrated competence and intervention-related difference from definitive causation.

2. Literature Review

Virtual post-discharge nursing is situated at the intersection of care transitions, family-centered pediatric practice, and technology-mediated healthcare. Post-discharge care refers to support provided after a patient leaves hospital to reinforce treatment recommendations, monitor recovery, maintain communication, and coordinate further assessment when necessary. In pediatric practice, this process is mediated substantially by caregivers. Children differ in developmental capacity, ability to describe symptoms, dependence on adults, and clinical complexity. Caregivers therefore become active partners in medication administration, observation, reporting, and communication. Research on pediatric transitions shows that satisfaction and continuity depend on the quality of nursing preparation and follow-up, not solely on the clinical condition at discharge (Cechinel-Peiter et al., 2023).

Virtual delivery can extend selected elements of this nursing role beyond the hospital. Telephone or video contact may allow nurses to reinforce instructions, respond to questions, review symptoms, assess adherence, and coordinate escalation. Evidence from nurse-led pediatric telehealth follow-up suggests potential value for accessibility and continuity, particularly when families otherwise face travel or scheduling barriers (Forster et al., 2023). Studies of telehealth follow-up in specific pediatric services also indicate that remote contact can be feasible for defined purposes (Smith et al., 2022). These applications remain bounded: technology cannot reproduce every component of physical assessment, and remote contact is inappropriate when the child's condition requires direct examination or urgent intervention.

The caregiver's role makes pediatric virtual follow-up distinct from many adult encounters. Depending on the child's age and condition, the nurse may obtain information indirectly, ask a caregiver to describe or show a symptom, and rely on the caregiver to implement advice. Communication must therefore be structured enough to elicit clinically relevant observations while remaining understandable to families. Discharge-transition evidence shows that caregivers' experience of nursing communication is closely connected to continuity and satisfaction (Cechinel-Peiter et al., 2023). Virtual nursing education must consequently address how nurses confirm understanding, recognize uncertainty in caregiver reports, and avoid extending a remote encounter beyond safe clinical limits.

The independent variable in the present article is a structured educational intervention on virtual post-discharge nursing. Such an intervention is not simply instruction in how to operate a platform. Responsible virtual nursing encompasses communication, remote information gathering, documentation, confidentiality, caregiver engagement, professional accountability, warning-sign recognition, and escalation. Contemporary accounts of virtual nursing roles emphasize that technological knowledge must be integrated with nursing judgment and organizational processes (Mubarak Al Baalharith & Aboshaiqah, 2024). Education may reduce unfamiliarity and help nurses form more informed evaluations of virtual care, but it cannot by itself supply infrastructure, staffing, governance, or verified clinical competence.

The first dependent variable is nurses' perception of virtual post-discharge nursing clinics. In this study, perception comprises beliefs and evaluations concerning usefulness, continuity, communication, quality, benefits, efficiency, safety, and integration into pediatric practice. Perception is broader than simple approval. Nurses may recognize advantages in access and follow-up while expressing reservations about workload, technology reliability, remote examination, caregiver digital literacy, and accountability. Evidence from child-health and other clinical settings shows that professional acceptance is conditional on the fit between a technology and the work that clinicians must perform. Telehealth is more likely to be viewed favorably when it supports a clearly defined clinical purpose and is embedded in reliable systems.

Perceived usefulness is central to those evaluations. If nurses believe that virtual follow-up helps them sustain communication, reinforce discharge plans, or identify concerns earlier, they may be more receptive to the model. Conversely, perceptions may be less favorable when virtual contact appears to add workload without providing clinical benefit. Nurses also evaluate whether remote communication permits sufficiently meaningful interaction with children and caregivers. Best-practice research in nurse-led telehealth stresses the importance of purposeful communication, role clarity, and systems that preserve nursing standards across modalities (Weiss et al., 2024).

Safety and clinical appropriateness form another dimension of perception. Remote interaction relies on what can be seen, heard, or reported through the selected technology. In pediatrics, a parent may need to describe behavior, symptoms, intake, medication administration, or visible changes. The nurse must decide whether the information is adequate and whether the situation exceeds the scope of virtual contact. Perceptions of safety are therefore likely to depend on clear eligibility criteria and escalation procedures. Education that presents both appropriate uses and explicit limitations may produce a more informed view rather than unqualified enthusiasm.

The second dependent variable is perceived readiness, defined as nurses' self-reported preparedness, confidence, willingness, and perceived capability to participate in virtual post-discharge nursing. It includes confidence in using telehealth technologies, conducting appropriate aspects of remote assessment, communicating with caregivers, managing selected concerns, and integrating virtual contact into practice. It is essential to retain the modifier perceived. The construct does not demonstrate that a nurse can perform a virtual consultation safely under observation, nor does it establish that an organization is ready to operate a service.

Telehealth-readiness research portrays preparedness as multidimensional. A large study of Chinese clinical nurses found that readiness varied with prior exposure, willingness, and innovative self-efficacy (Yu-Tong et al., 2022). Research among specialist nurses similarly connected readiness with knowledge, confidence, and implementation conditions (Guo et al., 2023). A perinatal nursing study found that limited workplace use could coexist with recognition of telehealth's value (Talmont & Vitale, 2022). Together, these findings support the conceptual distinction between positive evaluation and felt preparedness.

Readiness also exists within an organizational environment. Secure platforms, stable connectivity, technical assistance, protected time, leadership support, documentation systems, and clear protocols may shape whether

nurses feel able to act on what they know. A community-readiness model for telemedicine likewise frames successful implementation as a process involving more than individual attitude (Otto et al., 2023). Individual education can address knowledge and confidence, but it cannot substitute for staffing, workflow design, governance, or system reliability. This is particularly relevant when a scale item asks whether nurses feel supported in implementation, because the response may reflect institutional conditions as much as personal preparation.

Organizational context may also determine whether positive perceptions persist. A nurse who values virtual follow-up may become less receptive if consultations are added to an already full workload, systems fail repeatedly, or accountability remains unclear. Conversely, reliable technology and visible managerial support can make the same clinical model appear more feasible. This interaction means that an education study estimates change under particular institutional conditions. It does not establish a context-free effect that will reproduce automatically in every hospital. Hospital-level allocation in the current study makes this issue especially salient because the intervention condition and institutional setting cannot be fully separated.

The relationship between education and perception has received support across professional-learning studies. Telehealth education has been associated with improved provider experience and adoption-related attitudes (Garber & Gustin, 2022). Educational exposure may make the purpose, workflow, and boundaries of virtual practice more concrete, allowing clinicians to judge usefulness against professional tasks. Asante's (2024) work on knowledge, confidence, and attitudes toward virtual care also informed the perception measure adapted for the present study. Nevertheless, education-related changes in attitude should not be interpreted automatically as evidence of actual use, and favorable evaluation may diminish if organizational barriers remain unresolved.

Education may also influence perceived readiness by increasing familiarity and reducing uncertainty. A multi-setting pretest-posttest study reported gains in nurses' knowledge and self-efficacy after tailored telehealth training, while changes in actual telehealth use differed across settings (van Houwelingen et al., 2021). This distinction is instructive: an educational intervention may affect proximal self-reported outcomes more readily than behavior. Reviews recommend that telehealth curricula combine knowledge with applied activities that prepare clinicians for technology-mediated communication and decision-making (Chike-Harris et al., 2021). More recent discussions of training needs similarly emphasize that professional empowerment requires content matched to implementation demands (Mantziari et al., 2025).

The Technology Acceptance Model provides the theoretical lens for the current relationships. TAM proposes that evaluations of usefulness and ease of use are relevant to attitudes and intentions concerning technology. Healthcare research continues to use the model to explain why perceived value and usability matter to acceptance (Nazari-Shirkouhi et al., 2023). In this article, TAM is applied cautiously. The perception scale includes evaluations that overlap conceptually with usefulness, but the study did not separately measure the complete original TAM constructs, estimate mediation, or observe use behavior. Perceived readiness is also not treated as an original TAM variable. Rather, TAM helps explain why structured information about clinical applications and practical requirements may be associated with nurses' evaluations, while the broader conceptual framework places perceived readiness as a parallel outcome.

The Saudi context gives these relationships practical significance. A systematic review describes telehealth as part of the transformation of nursing care in Saudi Arabia (Al Baalharith et al., 2022). National digital-health growth creates opportunities for virtual service models, but local acceptance and preparation may vary by specialty and institution (AlWatban et al., 2024). Saudi healthcare-provider research has reported moderate-to-high telehealth readiness alongside differences associated with professional and demographic characteristics (Moussa et al., 2023). Nursing-student research has also documented variation in awareness, knowledge, and attitudes toward telehealth (Alshammari et al., 2024). These findings cannot establish the readiness of pediatric nurses in Madinah or the effect of a pediatric-specific educational module.

The research gap therefore has four linked dimensions. First, much telehealth research concerns adult, primary-care, chronic-disease, or mixed professional populations rather than pediatric nurses supporting the transition from hospital to home. Second, descriptive surveys cannot show whether perceptions and perceived readiness change following targeted preparation. Third, the two constructs are often treated interchangeably even though acceptance does not equal preparedness. Fourth, national digital advancement does not establish readiness in a specific regional and institutional context. A comparison-group pretest-posttest evaluation addresses part of this gap by testing change in both constructs after a defined educational exposure.

The expected relationships are deliberately proximal. A short educational module is most plausibly connected to immediate evaluations, familiarity, and perceived confidence, not to distal outcomes such as clinical performance, service utilization, or readmission. This ordering guards against overclaiming. The intervention can be considered associated with reported score change if the original tests support that conclusion, but evidence about competence or patient benefit would require different measures and an operational service. Framing the outcomes in this way also preserves the conceptual distinction between intention or willingness and behavior that has actually occurred.

The resulting model is intentionally parsimonious: educational exposure is the independent condition, and perception and perceived readiness are separate dependent outcomes. No mediator or moderator is specified because none was tested in the reported analyses.

The hypotheses retained for this article map directly to the broader study's original H1-H4:

H1: There is a statistically significant difference in pediatric nurses' perception scores before and after the educational intervention in the intervention group.

H2: There is a statistically significant difference in pediatric nurses' perceived-readiness scores before and after the educational intervention in the intervention group.

H3: There is a statistically significant difference in perception change scores between pediatric nurses in the intervention and comparison groups.

H4: There is a statistically significant difference in perceived-readiness change scores between pediatric nurses in the intervention and comparison groups.

3. Methodology

The article reports a focused analysis from a broader research project examining pediatric nurses' perceptions and perceived readiness regarding virtual post-discharge nursing clinics. It retains the original variables, measurements, group structure, statistical tests, and reported results; no data were reanalyzed and no reduced model was estimated. The design was quantitative and nonrandomized quasi-experimental, with pre-intervention and post-intervention measurement in an intervention group and a comparison group. Participants were assigned by hospital setting rather than individually randomized. This arrangement was intended to reduce exchange of training materials across conditions and permit delivery within routine services, but it leaves open the possibility of site-related differences. The design consequently supports cautious interpretation of intervention-related change rather than definitive causation.

The study took place in selected healthcare institutions in Madinah, Saudi Arabia. The target population consisted of registered nurses providing pediatric hospital care, while the accessible population was approximately 225 eligible pediatric nurses in participating hospitals. The individual nurse was the unit of analysis. The planned sample of 144 was derived from the stated finite accessible population using a 5% precision level. Non-probability purposive sampling was used, and recruitment continued until 144 participants had enrolled. The intervention and comparison groups each comprised 72 nurses.

Eligible participants were registered nurses working directly in pediatric clinical areas in one of the selected hospitals, with at least six months of pediatric nursing experience, active availability during the study period, sufficient comprehension of the study language, and voluntary informed consent. Nursing students, interns, assistants, non-pediatric nurses, nurses with less than six months of pediatric experience, nurses working exclusively in nonclinical roles, and nurses unavailable for the required measurements were excluded. Participants unable to complete the study procedures or post-intervention assessment were eligible for exclusion from complete-case analysis. The final thesis reports that all enrolled participants completed the required assessments.

Data were collected through a structured self-administered questionnaire at both measurement points. Section A captured age, gender, educational qualification, total nursing experience, pediatric nursing experience, prior telehealth exposure, and previous digital or virtual-health training. Section B contained a 10-item perception scale adapted from Asante (2024). Its positively worded statements addressed continuity, effectiveness of follow-up, caregiver communication, quality, family benefit, complementarity with traditional services, attitude toward virtual platforms, efficiency, safe transition, and integration into routine pediatric care. Responses ranged from 1 (strongly disagree) to 5 (strongly agree). The total ranged from 10 to 50, with higher scores representing more favorable perceptions; no item was reverse scored.

Section C contained 10 perceived-readiness items adapted from the Telehealth Readiness Assessment Tool described by Bingham et al. (2022). Items covered self-reported preparedness to provide virtual post-discharge care, confidence with telehealth technology, capability for appropriate virtual assessment, comfort communicating with caregivers, willingness to integrate virtual nursing, technical preparedness, confidence managing selected concerns, perceived support, readiness to adopt virtual nursing, and perceived possession of required skills. Responses used the same five-point scale and produced totals from 10 to 50. Higher values indicated greater perceived readiness, not objectively verified competence. The thesis also used descriptive mean-score classifications of very low (1.00-1.80), low (1.81-2.60), moderate (2.61-3.40), moderate-high (3.41-4.20), and high (4.21-5.00). These categories were interpretive intervals rather than validated clinical thresholds.

The adapted questionnaire underwent qualitative review by five experts in pediatric nursing, nursing education, telehealth or digital healthcare, and research methodology. The review addressed relevance, clarity, comprehensibility, and contextual fit. No numerical content-validity index was calculated. An Arabic version was prepared through documented forward-backward translation: a bilingual individual familiar with nursing

terminology translated the English instrument into Arabic, an independent bilingual individual back-translated it, and discrepancies were discussed before finalization. Fifteen pediatric nurses with characteristics comparable to the target participants completed pilot testing and were excluded from the main sample. The available pilot documentation states only that alpha coefficient for the two principal scales exceeded .70; exact pilot coefficients were not available.

The intervention was one standardized 20-minute virtual training module delivered through a web-based platform. Four components of approximately five minutes each covered: the meaning and relevance of virtual pediatric post-discharge nursing; nursing roles, communication, ethics, privacy, and confidentiality; practical follow-up processes, assessment considerations, warning signs, documentation, and caregiver engagement; and perceived barriers, confidence, and readiness. Documented methods included slides, guided explanation and discussion, case-based pediatric examples, demonstration, and reflection. The same content, sequence, duration, mode, and delivery format were used for intervention participants. No formal quantitative fidelity checklist, attendance record, facilitator-monitoring record, or adherence measure was reported. Facilitator characteristics and the exact interval between the session and the post-intervention assessment were not documented.

Both groups completed the baseline questionnaire before the intervention period. Only the intervention group received the module; the comparison group continued usual professional activity and did not receive it during the principal evaluation period. Both groups then completed the same outcome measures. Unique study codes linked repeated questionnaires while avoiding names in the analytical dataset. The thesis reports that all questionnaires were complete, so no imputation, deletion, or substitution was performed. Valid extreme observations were retained, and no cases were excluded as problematic outliers.

Procedural standardization was the documented approach to consistency. Intervention participants received the same planned content, order, total duration, virtual mode, and web-based format. The comparison group was not provided the module during the main evaluation period, and intervention materials were reportedly restricted to the intervention condition. Because staff may communicate professionally or socially, hospital-level separation could reduce but not eliminate contamination. Similarly, identical pretest and posttest measures improved comparability across occasions but introduced a possible testing effect. These design features were retained in the article because they are necessary to understand both the strength and the limits of the reported comparisons.

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS); the version was not reported. Frequencies and percentages described categorical variables, and means and standard deviations summarized scale scores. Distributional assessment used skewness, kurtosis, graphical inspection, Kolmogorov-Smirnov tests, and Shapiro-Wilk tests. Because relevant measures departed from normality and originated from Likert-type items, the principal pretest-posttest and between-group analyses used nonparametric procedures. H1 and H2 were tested within the intervention group with Wilcoxon signed-rank tests. For H3 and H4, individual change scores were calculated as posttest minus pretest, then compared between groups using Mann-Whitney U tests. Reported effect size was r = |Z| / square root of N. Statistical significance was evaluated at alpha = .05. Main-study Cronbach's alpha coefficients were .762 for perception and .702 for perceived readiness.

The analytical roles of the tests were kept distinct. The paired Wilcoxon tests addressed whether scores changed over time among the 72 nurses exposed to the module. They did not use the comparison group and therefore could not distinguish education-related change from history, repeated measurement, or other concurrent influences. The Mann-Whitney tests addressed whether the distributions of individual change scores differed between the two independent groups over the same period. Those comparisons provided the stronger intervention-related evidence, while nonrandom allocation continued to prevent definitive causal inference. Demographic variables were descriptive or exploratory; no moderation, mediation, multivariable prediction, or covariate-adjusted effect was reported.

The thesis states that ethical and administrative approvals were obtained, written informed consent was collected, participation was voluntary, and confidentiality and withdrawal rights were protected. It does not provide the approving authority, approval number, or approval date. No patient or caregiver data were collected, and participation did not authorize nurses to practice outside their professional scope.

4. Results

4.1 Response Rate

All 144 distributed questionnaires were returned and usable, producing the 100.0% response and completion rate reported in the thesis. No questionnaires were unreturned or excluded as incomplete. The final analytical sample therefore comprised 144 pediatric nurses, with 72 participants in the intervention group and 72 in the comparison group. No participant-level attrition was reported between pretest and posttest.

The response accounting was therefore identical at distribution, return, and analysis: the full set of questionnaires issued for the reported sample entered the analysis. The equal group sizes were maintained in the reported within-group and between-group tests. Accordingly, the Wilcoxon signed-rank analyses used the 72 intervention

participants, while the Mann-Whitney U analyses used the combined sample of 144 nurses across both study conditions. Table 1 reports only the response categories explicitly documented in the thesis and does not infer reasons for nonresponse because none occurred in the reported sample.

Table 1. Response Rate and Usable Questionnaires

Questionnaire status	Frequency	Percentage
Total distributed	144	100.0%
Returned responses	144	100.0%
Unreturned	0	0.0%
Incomplete responses	0	0.0%
Usable responses	144	100.0%

4.2 Preliminary Data Analysis

Screening indicated that the 144 questionnaires contained no missing demographic or scale responses. Consequently, no imputation, substitution, listwise deletion, or pairwise deletion was performed. The thesis also reports that no problematic extreme outliers were identified, and all valid observations were retained. Skewness and kurtosis values did not show severe departure from symmetry at baseline; however, several formal normality tests were statistically significant. The analysis therefore used nonparametric procedures for the paired and independent-group hypothesis tests.

As shown in Table 2, both formal tests rejected normality for pretest perception. Pretest perceived readiness also produced statistically significant Kolmogorov-Smirnov and Shapiro-Wilk results. At posttest, perception remained significant under both tests. The posttest perceived-readiness score produced a significant Kolmogorov-Smirnov result but a nonsignificant Shapiro-Wilk result ($p = .063$). Because the evidence was mixed for that score and departures were present elsewhere, the thesis retained a consistent nonparametric strategy across the four hypothesis tests. No transformation of the scale scores was reported.

Table 2. Normality Tests for Perception and Perceived-Readiness Scores

Variable	Kolmogorov-Smirnov statistic	K-S p	Shapiro-Wilk statistic	S-W p
Pretest perception mean	0.112	< .001	0.956	< .001
Pretest perceived-readiness mean		.010	0.970	.003
Posttest perception mean	0.113	< .001	0.965	.001
Posttest perceived-readiness mean	0.114	< .001	0.982	.063

4.3 Reliability Analysis

Internal consistency was evaluated separately for the two variables retained in the article. The 10-item perception scale produced a Cronbach's alpha of .762, while the 10-item perceived-readiness scale produced an alpha of .702. These coefficients were interpreted in the thesis as satisfactory internal consistency. They describe reliability only and are not evidence of content or construct validity.

Both estimates were calculated from the main study data and refer to the complete 10-item form of each measure. The perception coefficient was numerically higher than the perceived-readiness coefficient, but both measures were retained without item deletion in the reported analysis. The article therefore presents the scale composition and coefficients as documented and does not introduce factor-analytic or item-reduction results that were not reported in the thesis.

Table 3. Reliability of the Study Measures

Measure	Number of items	Cronbach's alpha
Nurses' perceptions	10	.762
Nurses' perceived readiness	10	.702

4.4 Descriptive Analysis

The group-specific results table reported similar starting values for the two study variables. Baseline perception was $M = 3.06$ ($SD = 0.48$) in the intervention group and $M = 3.08$ ($SD = 0.47$) in the comparison group. Baseline perceived readiness was $M = 2.94$ ($SD = 0.51$) and $M = 2.97$ ($SD = 0.50$), respectively. At posttest, the reported perception mean was 3.54 ($SD = 0.40$) in the intervention group and 3.19 ($SD = 0.50$) in the comparison group.

The corresponding perceived-readiness means were 3.49 (SD = 0.40) and 3.15 (SD = 0.50). These descriptive values do not replace the change-score tests used to evaluate H3 and H4.

Table 4. Descriptive Scores for the Article Variables by Group and Measurement Occasion

Variable and occasion	Intervention, M (SD)	Comparison, M (SD)
Perception at baseline	3.06 (0.48)	3.08 (0.47)
Perception at posttest	3.54 (0.40)	3.19 (0.50)
Perceived readiness at baseline	2.94 (0.51)	2.97 (0.50)
Perceived readiness at posttest	3.49 (0.40)	3.15 (0.50)

The thesis further presented posttest item-level results for each variable. Perception item means ranged from 3.45 to 3.60 in the intervention group and from 3.10 to 3.30 in the comparison group. No item-level inferential tests were reported; therefore, the table presents descriptive comparisons only.

Within the intervention group, the highest perception means were reported for continuity of pediatric care and a positive attitude toward virtual platforms, both at M = 3.60. The lowest was reported for enhanced quality of post-discharge care at M = 3.45. In the comparison group, nurse-caregiver communication had the highest mean at 3.30, whereas enhanced quality, positive attitude, and integration into routine care each had a mean of 3.10. Every intervention-group perception item was classified as moderate-high, while every comparison-group item was classified as moderate in the thesis.

Table 5. Posttest Perception Scores by Study Group

Perception item	Intervention M (SD)	Comparison M (SD)	Intervention level	Comparison level
Improves continuity of pediatric care	3.60 (0.50)	3.20 (0.60)	Moderate-high	Moderate
Effective for post-discharge monitoring	3.55 (0.52)	3.25 (0.55)	Moderate-high	Moderate
Improves nurse-caregiver communication	3.58 (0.48)	3.30 (0.60)	Moderate-high	Moderate
Enhances quality of post-discharge care	3.45 (0.55)	3.10 (0.65)	Moderate-high	Moderate
Benefits pediatric patients and families	3.50 (0.50)	3.20 (0.58)	Moderate-high	Moderate
Adds value to traditional pediatric nursing	3.48 (0.52)	3.25 (0.60)	Moderate-high	Moderate
Positive attitude toward virtual platforms	3.60 (0.45)	3.10 (0.62)	Moderate-high	Moderate
Improves follow-up efficiency	3.55 (0.50)	3.20 (0.57)	Moderate-high	Moderate
Supports safer hospital-to-home transition	3.57 (0.48)	3.15 (0.60)	Moderate-high	Moderate
Should be integrated into routine care	3.52 (0.50)	3.10 (0.63)	Moderate-high	Moderate
Overall perception mean	3.54 (0.40)	3.19 (0.50)	Moderate-high	Moderate

Perceived-readiness item means ranged from 3.42 to 3.55 in the intervention group and from 3.00 to 3.25 in the comparison group. As with perception, the thesis did not report item-level inferential comparisons, so these values remain descriptive.

The highest intervention-group readiness means were reported for preparedness to provide care through virtual platforms and possession of the necessary skills, each at M = 3.55. Confidence in managing appropriate issues virtually had the lowest intervention-group mean at 3.42. In the comparison group, technical preparedness had the highest mean at 3.25, while capability to conduct virtual pediatric assessments had the lowest mean at 3.00. The thesis classified all 10 intervention-group readiness items as moderate-high and all 10 comparison-group items as moderate.

Table 6. Posttest Perceived-Readiness Scores by Study Group

Perceived-readiness item	Intervention M (SD)	Comparison M (SD)	Intervention level	Comparison level
Prepared to provide care through virtual platforms	3.55 (0.50)	3.20 (0.60)	Moderate-high	Moderate
Confident using telehealth technology	3.50 (0.52)	3.20 (0.55)	Moderate-high	Moderate
Capable of conducting virtual pediatric assessments	3.45 (0.55)	3.00 (0.60)	Moderate-high	Moderate
Comfortable communicating with caregivers	3.52 (0.48)	3.10 (0.65)	Moderate-high	Moderate
Willing to integrate virtual post-discharge nursing	3.48 (0.52)	3.20 (0.60)	Moderate-high	Moderate
Technically prepared to use telehealth platforms	3.50 (0.50)	3.25 (0.55)	Moderate-high	Moderate
Confident managing appropriate issues virtually	3.42 (0.55)	3.10 (0.60)	Moderate-high	Moderate
Supported in implementing virtual nursing services	3.45 (0.50)	3.15 (0.60)	Moderate-high	Moderate
Ready to adopt virtual nursing in discharge care	3.50 (0.48)	3.20 (0.58)	Moderate-high	Moderate
Possesses necessary skills for virtual care	3.55 (0.50)	3.10 (0.60)	Moderate-high	Moderate
Overall perceived-readiness mean	3.49 (0.40)	3.15 (0.50)	Moderate-high	Moderate

4.5 Within-Group Analysis

Wilcoxon signed-rank tests examined pretest-posttest differences within the intervention group. Perception changed significantly (Z = -2.850, p = .004), with a reported moderate effect size of r = .34; H1 was supported. Perceived readiness also changed significantly (Z = -2.950, p = .003), with a reported moderate effect size of r = .35; H2 was supported. These paired analyses show change among intervention participants but do not independently distinguish the educational module from time, repeated measurement, or other concurrent influences.

For both outcomes, the probability values were below the thesis's stated .05 criterion. The effect-size classifications reproduced in Table 7 were also the same: both were interpreted as moderate, with the perceived-readiness estimate slightly larger than the perception estimate. The test statistics, probability values, effect sizes, and hypothesis decisions are reported without recalculation.

Table 7. Within-Group Analysis for the Intervention Group

Outcome	Test and sample	Z	p	Effect size and decision
Perception: posttest versus pretest	Wilcoxon signed-rank, n = 72	-2.850	.004	r = .34, moderate; H1 supported
Perceived readiness: posttest versus pretest	Wilcoxon signed-rank, n = 72	-2.950	.003	r = .35, moderate; H2 supported

4.6 Between-Group Analysis

The Mann-Whitney U tests compared individual change scores between the intervention and comparison groups. Perception change differed significantly between groups (U = 2047.000, Z = -2.180, p = .029), with a small reported effect of r = .18; H3 was supported. Perceived-readiness change also differed significantly (U = 2412.000, Z = -2.050, p = .040), with a small reported effect of r = .17; H4 was supported. The intervention group was reported to have a higher mean rank for perceived-readiness change (79.00) than the comparison group (66.00). The U value and reported rank information are reproduced without recalculation and remain listed for author verification.

Both between-group probability values met the .05 decision criterion, although they were closer to the threshold than the corresponding within-group values. The thesis classified both effects as small. Perception showed the larger of the two reported between-group effect sizes, while perceived readiness showed the larger within-group estimate. These comparisons summarize the reported effect-size pattern; they do not alter the original hypothesis decisions.

Table 8. Between-Group Analysis of Change Scores

Outcome	Test and sample	U and Z	p	Effect size and decision
Perception change	Mann-Whitney U, N = 144	U = 2047.000; Z = -2.180	.029	r = .18, small; H3 supported
Perceived-readiness change	Mann-Whitney U, N = 144	U = 2412.000; Z = -2.050	.040	r = .17, small; H4 supported

4.7 Hypothesis Testing Summary

All four hypotheses retained for the article were supported in the final hypothesis table of the thesis. The within-intervention-group effects were reported as moderate, whereas the between-group differences in change were small. The more informative between-group results are consistent with modest intervention-related improvement in perception and perceived readiness. They do not establish objective clinical competence, sustained adoption, or definitive causation.

Table 9. Summary of Hypothesis Testing

Hypothesis	Relationship tested	Reported result	Effect size	Decision
H1	Within-intervention perception change	Z = -2.850, p = .004	r = .34, moderate	Supported
H2	Within-intervention perceived-readiness change	Z = -2.950, p = .003	r = .35, moderate	Supported
H3	Between-group perception change	U = 2047.000, Z = -2.180, p = .029	r = .18, small	Supported
H4	Between-group perceived-readiness change	U = 2412.000, Z = -2.050, p = .040	r = .17, small	Supported

5. Discussion

This article examined whether structured education was associated with changes in pediatric nurses' perceptions and perceived readiness regarding virtual post-discharge nursing clinics. The four reported hypotheses were

supported. Within the intervention group, both outcomes changed significantly with moderate effect sizes. More importantly for the comparison-group design, change differed significantly between conditions for perception and perceived readiness, although both between-group effects were small. The pattern is therefore consistent with an intervention-related improvement in two proximal, self-reported workforce outcomes. It does not demonstrate that the brief module definitively caused the differences or that nurses became objectively competent to deliver virtual pediatric follow-up.

For perception, the intervention-group Wilcoxon result indicated significant pretest-posttest change ($Z = -2.850$, $p = .004$, $r = .34$). The between-group change-score test also reached significance ($U = 2047.000$, $Z = -2.180$, $p = .029$), but the effect was small ($r = .18$). This distinction matters. The within-group result shows that participants reported different evaluations at two measurement occasions, while the comparison indicates that the distributions of change were different across conditions. The latter is more consistent with an intervention-related interpretation because it places the intervention group's change against contemporaneous change without the training exposure. Yet the small effect indicates that statistical detection should not be equated with a large practical shift.

The direction of the descriptive results supports a more favorable posttest evaluation in the intervention group. The module provided a concise overview of continuity, caregiver communication, professional roles, privacy, assessment limits, warning signs, documentation, and escalation. These topics map closely onto the benefits and concerns represented in the perception scale. Participants may therefore have been better able to evaluate virtual follow-up as a defined nursing activity rather than as an abstract technological proposal. This interpretation is plausible because ambiguity concerning purpose and scope can shape professional attitudes, but the study did not measure knowledge acquisition or the mechanism through which perceptions changed.

The perception finding is consistent with previous telehealth-education evidence. Garber and Gustin (2022) associated education with more favorable provider experience and adoption-related responses. Asante (2024) similarly linked knowledge, confidence, and attitudes in virtual-care education, and the current perception items were adapted from that source. The present article adds a pediatric, post-discharge, Saudi setting and a contemporaneous comparison condition. It cannot, however, establish that the same psychological process operated here, particularly because no separate measure of perceived usefulness, ease of use, or knowledge was analyzed.

The finding also corresponds to the multi-setting study by van Houwelingen et al. (2021), in which telehealth education improved nurses' knowledge and self-efficacy. Their observation that actual telehealth use varied by setting is especially relevant. Education may change proximal beliefs without guaranteeing implementation behavior. The present study measured perceptions of a proposed clinic rather than behavior in an operational service. Accordingly, a higher perception score should be understood as a more favorable reported evaluation, not evidence that nurses subsequently adopted telehealth or that the service performed effectively.

This boundary also helps place the favorable direction beside the modest between-group effect. Participants may have entered the study with some openness to virtual care, leaving limited room for a brief session to shift composite scores. The intervention addressed a broad set of clinical and professional topics in only 20 minutes, and different participants may have found different components relevant. Because the study did not measure knowledge, prior familiarity in detail, or engagement with each component, these explanations remain possibilities rather than established mechanisms.

TAM provides a coherent but limited explanation. The module described potential clinical usefulness and practical requirements, and the perception scale included judgments about continuity, communication, efficiency, safety, and integration. A more concrete understanding of those functions could plausibly be associated with a more favorable evaluation. This is compatible with healthcare applications of TAM in which perceived usefulness and ease of use are related to acceptance (Nazari-Shirkouhi et al., 2023). However, the study did not measure the full model, test mediation, or observe behavioral intention and use as separate outcomes. The result supports the relevance of technology-related evaluations; it does not validate a complete TAM pathway.

For perceived readiness, the intervention-group pretest-posttest difference was statistically significant ($Z = -2.950$, $p = .003$, $r = .35$). The between-group change-score result was also significant ($U = 2412.000$, $Z = -2.050$, $p = .040$), with a small reported effect ($r = .17$). The posttest descriptive score was higher in the intervention group, but the small differential change places an important boundary around interpretation. A single 20-minute module may help nurses feel more familiar with virtual nursing roles and processes, yet the magnitude does not support treating the session as a comprehensive readiness or competence program.

This result aligns with literature that identifies education as one component of telehealth preparation. Chike-Harris et al. (2021) argued for deliberate integration of telehealth into health-professional curricula because clinicians require preparation for technology-mediated care. Mantziari et al. (2025) likewise emphasized targeted programs to empower professionals adopting telehealth applications. In a pretest-posttest nursing study, tailored education improved self-efficacy (van Houwelingen et al., 2021). The current result extends this pattern to self-reported

readiness for pediatric virtual post-discharge care, while its comparison group provides a stronger point of reference than an uncontrolled before-after design.

The result should nonetheless remain explicitly about perceived readiness. The scale asked nurses whether they felt prepared, confident, capable, supported, willing, and skilled. Those judgments are valuable for implementation planning because a workforce that feels unprepared may be reluctant to engage. They are not equivalent to observed competence in remote assessment, digital communication, clinical reasoning, documentation, or escalation. The study included no simulation, observed consultation, competency checklist, or performance assessment. It also did not evaluate whether self-confidence was calibrated accurately to actual capability. Educational planning should therefore treat improved perceived readiness as a signal for further development, not as authorization for independent virtual practice.

Readiness is also shaped by factors beyond the intervention. Research among clinical nurses has related telehealth readiness to previous exposure, willingness, and innovative self-efficacy (Yu-Tong et al., 2022). Specialist-nurse evidence identifies knowledge, confidence, and contextual support as relevant factors (Guo et al., 2023). Saudi healthcare-provider research similarly situates readiness within professional and organizational conditions (Moussa et al., 2023). Because groups in the current study were organized by hospital, unmeasured differences in leadership, infrastructure, technology support, workload, and organizational culture may have contributed to differential change. The baseline tests reduced concern about measured differences but cannot remove site-level confounding.

The parallel changes in perception and perceived readiness are conceptually coherent without establishing that one caused the other. Education addressed both evaluative and preparatory content. Nurses may have formed more favorable judgments while also feeling more familiar with the tasks involved. The broader study reported a positive baseline association between the constructs, but this article does not treat perception as a mediator or predictor of readiness. Both are analyzed as parallel outcomes. This restraint is important because the brief module, shared method of measurement, and nonrandomized design do not identify a causal sequence.

The results have a specific theoretical contribution. They place two distinct workforce outcomes beside a focused educational exposure in a pediatric virtual-care context. TAM helps interpret the perception outcome, but perceived readiness expands the framework toward self-reported capability and contextual support. The findings therefore suggest that technology acceptance alone is an incomplete account of preparation for virtual nursing. A nurse may see value in the model yet still require technical, clinical, organizational, and governance support. Theoretical work on healthcare technology adoption should distinguish favorable evaluation, willingness, self-efficacy, competence, and organizational readiness instead of merging them into a single adoption construct.

Methodologically, the comparison-group pretest-posttest structure is an advance over a purely descriptive survey for this local question. The analyses also separate within-participant change from between-group differences in change and report effect sizes alongside p-values. This distinction prevents the statistically significant within-intervention results from carrying the entire interpretation. At the same time, the use of purposive sampling, hospital-level nonrandom allocation, and self-report requires caution. The reported small between-group effects indicate that a more rigorous, adequately powered evaluation is needed before firm conclusions about educational effectiveness are drawn.

For practice, the findings support including structured education when organizations explore pediatric virtual follow-up. Nursing leaders in Madinah and comparable settings can use the intervention content as a starting framework: the purpose and boundaries of virtual follow-up, caregiver communication, remote information gathering, privacy and confidentiality, documentation, warning signs, and escalation. Because the study did not measure competence, this content should be expanded into supervised, competency-based preparation before nurses assume independent clinical responsibilities. Case scenarios, simulation, observed virtual consultations, and explicit assessment criteria could test whether participants can apply knowledge safely.

The small effects also argue against relying on a brief standalone session. Organizations should pair education with secure platforms, reliable connectivity, technical support, protected time, staffing, documented workflows, and governance. A telemedicine community-readiness perspective emphasizes that successful scale-up depends on alignment across people, processes, and systems (Otto et al., 2023). Virtual follow-up should be integrated into pediatric pathways with clear eligibility criteria and referral routes. Nurses must be able to end or escalate a virtual encounter whenever the information available remotely is insufficient.

Family-centered design is equally important. Pediatric virtual care often depends on caregivers' ability to access technology, communicate observations, follow instructions, and recognize deterioration. The present study examined nurses only and cannot establish caregiver acceptability, digital access, or safety. A pilot service should therefore assess language needs, digital literacy, device and connectivity barriers, consent, privacy in the home, accessibility for children with complex needs, and mechanisms for urgent help. The intervention-related findings justify further preparation and pilot evaluation; they do not justify immediate broad deployment.

Several limitations constrain the findings. First, participants were not individually randomized, and each condition was linked to hospital setting. Selection and site-related confounding therefore remain plausible despite reported baseline comparability. Second, purposive recruitment from selected hospitals limits population representativeness. Third, both outcomes were self-reported and susceptible to social-desirability, expectancy, testing, and Hawthorne effects. Participants knew they were receiving educational attention, and repeated exposure to the questionnaire could itself influence responses.

Fourth, the study measured short-term change, but the exact interval between the educational session and posttest was not documented. Durability cannot be assessed. Fifth, intervention fidelity was represented by standardization of planned content, sequence, duration, and mode rather than by a measured fidelity process. Sixth, the adapted measures received qualitative expert review and translation, but no numerical content-validity index or reported factor analysis was available. The perceived-readiness scale's alpha of .702 is acceptable by the threshold applied in the thesis but leaves limited margin above .70. Finally, the study did not measure knowledge, objective competence, actual virtual-care behavior, organizational readiness, caregiver outcomes, clinical safety, healthcare utilization, or cost.

Future research should use multicenter randomized or cluster-randomized designs where feasible, with transparent allocation and site-level analysis. Follow-up at several time points is needed to determine whether changes persist. Educational interventions should be compared by duration and teaching strategy, and fidelity should be documented. Objective assessments should complement self-report through simulation, observed consultation, structured scenarios, and technology-performance checks. Measurement studies should examine factor structure, responsiveness, test-retest reliability, and equivalence across language and settings. Implementation pilots should then evaluate feasibility, workload, escalation, caregiver experience, equity of access, safety, readmissions, unplanned contacts, and costs. These steps would determine whether the promising proximal changes reported here translate into competent, sustainable, and beneficial pediatric care.

6. Conclusion

This article focused on one coherent component of a broader study: whether a structured educational module was associated with changes in pediatric nurses' perceptions and perceived readiness regarding virtual post-discharge nursing clinics. The study used a nonrandomized quasi-experimental pretest-posttest design in selected hospitals in Madinah, Saudi Arabia. A purposive sample of 144 pediatric nurses was divided by hospital setting into an intervention group and a comparison group of 72 participants each. Both groups completed adapted 10-item perception and perceived-readiness measures, while the intervention group received a standardized 20-minute web-based educational module. Wilcoxon signed-rank tests evaluated within-intervention-group change, and Mann-Whitney U tests compared individual change scores between groups.

As reported in the thesis, perceptions and perceived readiness changed significantly within the intervention group, with moderate effect sizes. Change also differed significantly between the intervention and comparison groups for both outcomes, although the between-group effects were small. The findings therefore support a cautious conclusion of modest intervention-related improvement. They do not establish that the module definitively caused the differences because allocation was nonrandomized and linked to hospital setting. They also do not show that nurses acquired objective competence, sustained the changes over time, adopted virtual practice, or improved outcomes for children and caregivers.

The theoretical value of the findings lies in distinguishing evaluation of a technology-supported care model from felt preparedness to participate in it. TAM offers a useful lens for understanding why education about clinical usefulness and practical requirements may be associated with perceptions. Perceived readiness, however, extends beyond acceptance and includes self-reported confidence, capability, willingness, and support. Treating the constructs as parallel outcomes avoids assuming that a favorable attitude automatically produces readiness or that confidence demonstrates competence.

The practical implication is similarly bounded. Structured education appears worthy of inclusion in workforce-preparation plans for pediatric virtual follow-up, but the reported small between-group effects do not support reliance on one brief session. Healthcare organizations should combine education with competency-based learning and assessment, secure technology, staffing, protected time, leadership support, documentation standards, privacy safeguards, patient-selection criteria, and explicit escalation pathways. Virtual nursing should complement, not replace, direct assessment when a child's condition cannot be evaluated safely at a distance.

This sequence places the current study at an early preparatory stage: it evaluates how nurses appraise the proposed model and how ready they feel, not whether a clinic has been implemented successfully. The appropriate next decision is therefore further verification and carefully controlled development, not an assumption of clinical effectiveness.

Interpretation must also acknowledge purposive sampling, selected hospitals, possible site confounding, self-report bias, repeated measurement, uncertain posttest timing, and the absence of objective or patient-level outcomes. The findings are most appropriately viewed as preliminary local evidence concerning two workforce-related outcomes during Saudi digital-health development. A carefully evaluated next phase should examine durable learning, demonstrated competence, organizational readiness, caregiver accessibility, and clinical feasibility. Only subsequent implementation and outcome studies can determine whether pediatric virtual post-discharge nursing is safe, equitable, sustainable, and beneficial. Within these boundaries, the current evidence suggests that structured education may be a useful starting component of preparation, provided it is embedded in a broader clinical and organizational readiness strategy.

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