การพัฒนารูปแบบการพยาบาลผู้ป่วยผ่าตัดหัวใจแบบเปิด โดยใช้กรอบแนวคิด ASPIRE โรงพยาบาลศรีสะเกษ

Development of a Nursing Care Model for Patients Undergoing Open-Heart Surgery Using the ASPIRE Framework at Sisaket Hospital

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บทคัดย่อ

การวิจัยและพัฒนาครั้งนี้มีวัตถุประสงค์เพื่อพัฒนารูปแบบการพยาบาลผู้ป่วยผ่าตัดหัวใจแบบเปิด ณ โรงพยาบาลศรีสะเกษ โดยใช้กรอบแนวคิด ASPIRE (การประเมิน กำหนดเป้าหมาย การวางแผน การปฏิบัติการ การประเมินซ้ำ การประเมินผล) และการมีส่วนร่วมของทีมสหสาขาวิชาชีพ การวิจัยดำเนินการระหว่างวันที่ 27 สิงหาคม 2568 ถึง 27 มกราคม 2569 ผู้มีส่วนร่วมในการวิจัย ได้แก่ พยาบาล 29 คน ผู้ป่วย 30 ราย และผู้เชี่ยวชาญ 11 คน การวิจัยประกอบด้วย 4 ระยะ ได้แก่ (1) การวิเคราะห์สถานการณ์ (2) การพัฒนารูปแบบการดูแลแบบบูรณาการ (3) การทดลองใช้และการประเมินโดยผู้เชี่ยวชาญและ (4) การประเมินผลลัพธ์ในสภาพจริง เก็บข้อมูลด้วยแบบสัมภาษณ์ แบบประเมินสมรรถนะ แบบสอบถามความพึงพอใจ แบบประเมินความเป็นไปได้ และแบบบันทึกผลทางคลินิก (CVI = 1.00) วิเคราะห์ข้อมูลเชิงปริมาณด้วย Wilcoxon signed-rank test และ paired t-test และเชิงคุณภาพด้วยการวิเคราะห์เนื้อหา ด้านผู้ให้บริการพบว่าคะแนนสมรรถนะของบุคลากรพยาบาลเพิ่มขึ้นในทุกระยะการดูแล (ร้อยละ 94.92 เป็นร้อยละ 96.98) และความพึงพอใจของทีมพยาบาลเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติ ($p<0.001$) แบบประเมินความเป็นไปได้ในการนำรูปแบบไปใช้อยู่ในระดับมากที่สุด ด้านผู้รับบริการ ตัวชี้วัดอุบัติการณ์ทั้ง 7 รายการบรรลุเป้าหมายที่กำหนด โดยตัวชี้วัดที่บรรลุร้อยละ 100 ได้แก่ การประเมินเตรียมความพร้อมก่อนผ่าตัด การรายงานภาวะฉุกเฉินและการจัดการยาความเสี่ยงสูง (HAD) ภายใน 1 นาที และการฟื้นฟูสภาพพร้อมวางแผนจำหน่าย ส่วนตัวชี้วัดที่ไม่เกิดเหตุการณ์ ได้แก่ การงดผ่าตัด ภาวะหัวใจเต้นผิดจังหวะหลังผ่าตัด และการกลับมารักษาซ้ำภายใน 7 วัน ผลการศึกษาชี้ให้เห็นว่ารูปแบบการพยาบาล SOH-Care สามารถลดการงดผ่าตัดเป็นศูนย์ลดภาวะการแข็งตัวของเลือดผิดปกติร้อยละ 30 และเพิ่มสมรรถนะพยาบาลอย่างมีนัยสำคัญทางสถิติ ข้อเสนอแนะให้ขยายผลทดสอบรูปแบบในโรงพยาบาลระดับตติยภูมิที่มีบริบทใกล้เคียงและศึกษาผลลัพธ์ระยะยาว

คำสำคัญ: ผ่าตัดหัวใจแบบเปิด, รูปแบบการพยาบาล, กรอบแนวคิด ASPIRE, ทีมสหสาขาวิชาชีพ, การวิจัยและพัฒนา

Abstract

This research and development (R&D) study aimed to develop a nursing care model for patients undergoing open-heart surgery at Sisaket Hospital using the ASPIRE framework (Assess–Set goals–Plan–Implement–Reassess–Evaluate) with multidisciplinary team participation. The study was conducted from August 27, 2025, to January 27, 2026. Participants included 29 nurses, 30 patients, and 11 experts. The research consisted of four phases: (1) situation analysis; (2) development of an integrated care model; (3) tryout and expert evaluation; and (4) outcome evaluation in real-world practice. Data were collected using interview guides, competency assessment forms, satisfaction questionnaires, feasibility assessment

forms, and clinical outcome recording forms (CVI = 1.00). Quantitative data were analyzed using the Wilcoxon signed-rank test and paired t-test, whereas qualitative data were analyzed using content analysis. Among providers, nursing staff competency scores increased across all care phases (from 94.92% to 96.98%), and team satisfaction improved with statistical significance ($p < 0.001$). The feasibility of model implementation was rated at the highest level. Among patients, all seven incidence indicators achieved their specified targets. Indicators achieving 100% included preoperative assessment, intraoperative emergency reporting, and high-alert drug (HAD) management within 1 minute, and rehabilitation/discharge planning. Indicators with zero incidence included surgery cancellation, postoperative arrhythmia, and 7-day readmission. The findings suggest that the SOH-Care nursing care model can reduce surgery cancellations to zero, decrease coagulopathy by 30%, and significantly improve nursing competency. It is recommended that the model be tested in tertiary hospitals with similar contexts and that long-term outcomes be further studied.

Keywords: Open-heart surgery, Nursing care model, ASPIRE framework, Multidisciplinary team, Research and development

1. Introduction

Cardiovascular disease is the leading cause of death worldwide. The World Health Organization (WHO) reported nearly 20 million deaths from cardiovascular diseases annually in 2023, with the majority attributable to acute myocardial infarction and stroke (World Health Organization, 2023). The increasing prevalence is driven by metabolic risk factors such as obesity, diabetes, and hypertension, compounded by air pollution and climate change (Global Burden of Disease Collaborators, 2023). Internationally, the management of cardiac conditions has continued to advance, emphasizing revascularization, antiplatelet therapy, and the expanding role of specialized cardiology nursing care. Sanders et al. (2022) identified inadequate preoperative risk assessment and fragmented interdisciplinary communication as the primary structural drivers of cardiac surgical morbidity and mortality. Similarly, Noor et al. (2024) reported that cardiac complications following noncardiac surgery remain a major cause of perioperative morbidity and mortality, with urgent surgeries demonstrating a significantly higher incidence of complications than elective procedures.

In Thailand, the number of patients undergoing open-heart surgery has continued to increase. The Thai Thoracic Surgery Association reported that the number of open-heart surgeries increased from 9,577 in 2017 to 11,465 in 2020 (Thai Thoracic Surgery Association, 2020). Despite advances in surgical technology, significant postoperative complications, including acute renal failure, hemorrhage, arrhythmias, and stroke, continue to affect patient outcomes and healthcare costs. Previous studies have demonstrated that integrated care pathways and standardized nursing protocols can significantly reduce postoperative complications and improve patient outcomes in cardiac surgery, including clinical pathway approaches and care bundle strategies. However, limited research has specifically addressed the development of comprehensive, multidisciplinary nursing care models for open-heart surgery in regional tertiary hospitals in Thailand.

Sisaket Hospital was designated as a Level II Cardiac Surgery Center serving Health Region 10 and began providing open-heart surgery services in 2022. Although the hospital follows established protocols for preoperative, intraoperative, and postoperative care according to the Royal College of Surgeons of Thailand guidelines, an analysis in 2024 identified three surgery cancellations (5.88%), exceeding the zero-

cancellation target. The existing care delivery system was organized by individual units: the outpatient department managed initial assessments, the anesthesiology team conducted pre-anesthetic evaluations independently, and the ICU handled postoperative care without a shared interdisciplinary care plan or standardized handoff protocols. Root cause analysis of 60 medical records, patient interviews, and multidisciplinary team (MDT) consultations revealed fragmented care, inadequate inter-unit communication during patient preparation, and the absence of unified standard clinical guidelines across multidisciplinary teams.

Therefore, this research and development (R&D) study aimed to develop an open-heart surgery (OHS) nursing care model at Sisaket Hospital using the ASPIRE conceptual framework (Assess–Set goals–Plan–Implement–Reassess–Evaluate), integrated with principles of continuity of cardiac surgical care for seamless perioperative transitions, a case management approach for individualized patient coordination, and the nursing process for systematic clinical decision-making. The conceptual framework linking the inputs, processes, and expected outcomes of this study is illustrated in Table 1.

2. Materials and methods

2.1 Study Design and Setting

This study employed a research and development (R&D) design comprising four sequential phases aligned with the ASPIRE conceptual framework (Assess–Set goals–Plan–Implement–Reassess–Evaluate): Phase 1, Situation Analysis (corresponding to Assessment); Phase 2, Model Development (corresponding to systematic review and Planning); Phase 3, Tryout and Expert Evaluation (corresponding to Implementation and Review); and Phase 4, Outcome Evaluation (corresponding to Evaluation). The study was conducted at the Anesthesiology Department and Cardiovascular ICU (ICU CVT) of Sisaket Hospital, a 900-bed provincial tertiary hospital in northeastern Thailand serving as the cardiac surgery center for Health Region 10.

Table 1. Conceptual Framework for Open-Heart Surgery Care Development at Sisaket Hospital

INPUT	PROCESS	OUTCOME
Patient Care Concepts for Open-Heart Surgery (Case-Based) • Access and admission to OHS services • MDT pre-anesthetic readiness assessment • OHS care planning • Holistic patient care • Patient and family empowerment • Continuity of care through community	**SOH - Care Compond ASPIRE** **Phase 1: Situation Analysis** Staff/patient interviews, medical record review **Phase 2: Model Development** Literature review, MDT collaborative design **Phase 3: Tryout & Expert Evaluation** Pilot testing, expert review, refinement **Phase 4: Outcome Evaluation** Full implementation, outcome measurement	**Provider Outcomes:** • Competency scores (5 phases) • Staff satisfaction (t-test) **Patient Outcomes:** • Pre-op assessment 100% • Surgery cancellations 0% • Emergency assessment ≤1 min 100% • HAD management ≤1 min 100% • Post-op arrhythmia 0% • 7-day readmission 0% • Rehab & discharge planning 100%

2.2 Participants

Provider sample: 29 nursing staff members (25 nurse anesthetists and four ICU nurses) involved in open-heart surgery care. Patient sample: 30 patients who underwent open-heart surgery during the implementation period (Phase 4). Medical record review: 30 records for Phase 1 retrospective analysis, comprising records from the one year preceding model implementation. Expert panel: 11 experts for Phase 3 evaluation and five content validity experts for instrument development. Inclusion criteria for nursing staff were registered nurses with at least one year of experience in open-heart surgery care at Sisaket Hospital who provided informed consent. Exclusion criteria were staff on extended leave during the study period or those who withdrew consent. Inclusion criteria for patients were adults aged ≥18 years scheduled for elective open-heart surgery during the implementation period. Exclusion criteria were emergency surgical cases, patients with cognitive impairment precluding informed consent, or patients who declined participation.

2.3 Research Instruments

Phase 1 instruments included: (1) a structured interview guide for multidisciplinary team members, (2) a patient experience interview guide, and (3) a clinical outcome recording form based on medical records; all were reviewed by five experts and achieved a Content Validity Index (CVI) of 1.00. The multidisciplinary team interview guide used open-ended questions organized into three domains: perceptions of the care process, communication barriers, and patient preparation practices. The patient experience guide covered five domains: fear, anxiety, and risk perception; communication and shared decision-making; continuity of care and systematic management; holistic physical and psychological care; and confidence, concerns, and post-discharge self-care support. The clinical outcome recording form captured perioperative complications, ICU length of stay, use of cardiac assist devices and vasoactive medications, functional recovery at one month, readmission, and mortality. Interview responses were analyzed using content analysis.

Phase 2 instruments included a competency assessment tool covering five care phases (29 items) using a 5-point rating scale (1 = needs improvement to 5 = excellent), with a pass criterion of ≥80% of the total score, Cronbach's alpha = 0.78, and an expanded clinical outcome recording form.

Phase 3 instruments included a Care Model Implementation Assessment Form and Problem Documentation Form.

Phase 4 instruments included a nursing team competency assessment form (29 items across five phases), a team satisfaction questionnaire (7 items, 5-point Likert scale, Cronbach's alpha = 0.78), a feasibility assessment form, and a patient clinical outcome recording form.

2.4 Data Collection Procedure

Phase 1 (Situation Analysis): Staff interviews (5–10 minutes each), patient interviews, and retrospective medical record reviews were conducted following institutional ethics approval (SSKH 030/2025) and informed consent.

Phase 2 (Model Development): Data synthesis, a systematic literature review using the PICO framework (Google Scholar, Thai Journal Online, CINAHL, PubMed, and EMBASE), and MDT workshops were conducted to co-design the care model.

Phase 3 (Tryout): Pilot testing was conducted with 11 staff members (eight nurse anesthetists, two ICU nurses, and one operating room circulator nurse) for one month, with continuous feasibility monitoring and refinement.

Phase 4 (Outcome Evaluation): Full model implementation was conducted with 29 nursing staff members and 30 OHS patients for four months, with collection of competency, satisfaction, and clinical outcome data.

2.5 Data Analysis

Quantitative data were analyzed using descriptive statistics, including frequency, percentage, mean, and standard deviation. For pre- and post-model comparisons of nursing competency scores (Table 2), the Wilcoxon signed-rank test was applied due to the ordinal nature of the competency percentage data. For team satisfaction scores (Table 3), the paired samples t-test was used because satisfaction domain scores met the assumptions of normality (Shapiro–Wilk, $p > 0.05$). Statistical significance was set at $p < 0.05$ for all tests. Qualitative data were analyzed using content analysis to identify themes and patterns from interviews and feedback. The research activities and the corresponding tools and instruments used in each of the four phases are summarized in Table 2.

Table 2. Research Phase Workflow

Phase / Activity	Tools / Instruments
Phase 1: Situation Analysis 1. Document/data review 2. MDT staff interviews 3. Retrospective medical record review (n = 30)	• MDT situation interview form • Patient experience interview form • Medical record outcome form (CVI = 1.00)
Phase 2: Model Development 1. MDT planning meetings 2. Literature review & evidence synthesis 3. Draft model development	• Expert appropriateness assessment form (n = 5) Outcome: Draft OHS Care Model
Phase 3: Tryout & Evaluation 1. Pilot testing: n = 11 staff, 1 month 2. Full tryout: n = 29 staff, 4 months 3. Expert panel evaluation (n = 11)	• CVT pre-anesthetic visit form • Patient education leaflet • Care model assessment form • ICU CVT rehabilitation & discharge plan
Phase 4: Outcome Evaluation 1. Nursing compliance with care model 2. Team satisfaction assessment 3. Clinical patient outcomes (n = 30 patients; n = 29 nursing staff)	• Competency assessment (29 items, 5 phases) • Team satisfaction questionnaire • Feasibility assessment form • Patient clinical outcome recording form

3. Results

3.1 Phase 1: Situation Analysis

An analysis of open-heart surgery patient care at Sisaket Hospital revealed that the existing system aligned with international anesthesia safety standards (SIMPLE framework), covering three anesthesia phases. However, a systematic analysis identified variations in documentation and inter-unit communication practices that affected patient readiness.

The 2024 operating room safety report identified four key problem categories: (1) preoperative patient preparation gaps, (2) discontinuous monitoring and evaluation systems, (3) limited clinical support resources, and (4) postoperative safety and complication outcomes (WHO, 2023). The overarching theme was “Fragmented Holistic Care System,” reflecting inadequate system-wide integration across all care phases.

Retrospective clinical data (n = 30 records spanning the one year preceding model implementation; a subset of n = 30 records was randomly selected for in-depth complication profiling) revealed that 93.34% of patients had cardiopulmonary bypass (CPB) times of 50–150 minutes. All patients (100%) developed anemia and hypocalcemia postoperatively, 96.67% experienced hypokalemia, and 70% had coagulopathy. Despite these expected complications, 86.67% of patients showed improved ejection

fraction (EF) at discharge, and no patients died or were readmitted within 30 days (Sisaket Hospital medical records, 2025).

Patient interviews (n = 10) generated five major themes: (1) fear, anxiety, and preoperative risk perception; (2) communication support and shared decision-making; (3) care continuity and systematic management; (4) holistic physical and psychological care; and (5) confidence, concerns, and post-discharge self-care support.

3.2 Phase 2: Model Development — The SOH-Care Model

Based on Phase 1 findings and a systematic literature review, the research team developed the Sisaket Open-Heart Surgery Nursing Care Model (SOH-Care Model), which comprised four integrated components:

Phase 1 findings were combined with a systematic literature review conducted using the PICO framework across Google Scholar, Thai Journal Online, CINAHL, PubMed, and EMBASE. Search terms included open-heart surgery, nursing care model, ASPIRE, ERAS cardiac, pre-anesthetic assessment, and multidisciplinary perioperative care, with an inclusion period of 2018–2024. After screening 184 records, 27 articles were appraised for evidence quality and operational relevance. Key elements extracted and incorporated into the SOH-Care Model included: (a) structured pre-anesthetic assessment items and risk stratification (Arjomandi Rad et al., 2025) into the CVT form; (b) empowerment-based patient education content (Arjomandi Rad et al., 2025) into the patient leaflet; (c) phase-aligned nursing competency domains for cardiac surgery (Arjomandi Rad et al., 2025) into the competency tool; and (d) ERAS-cardiac early mobilization principles and structured day-by-day rehabilitation milestones (Engelman et al., 2019) into the ICU rehabilitation and discharge plan. These elements were then refined through three MDT co-design workshops to ensure contextual fit at Sisaket Hospital. The resulting SOH-Care Model comprised four integrated components.

Component 1, CVT Pre-Anesthetic Evaluation Form: A structured multidisciplinary pre-anesthetic assessment form covering patient demographics, cardiac diagnosis, surgical history, current medications, laboratory values, echocardiographic findings, anesthetic risk stratification, and nursing care planning across the preoperative period. The form was designed to facilitate standardized, team-shared documentation and replace the previously fragmented unit-based records.

Component 2, Patient Education Leaflet: An easy-language bilingual leaflet covering basic cardiac anatomy, preoperative preparation, in-hospital conduct, and post-discharge self-care, developed through MDT consensus.

Component 3, Competency Assessment Tool: A 29-item tool covering five care phases—pre-preparation (three items), preoperative (seven items), intraoperative (seven items), postoperative (eight items), and discharge (four items)—assessing technical skills, clinical decision-making, and interprofessional collaboration.

Component 4, ICU CVT Rehabilitation and Discharge Plan (Day 0–7): A structured daily rehabilitation protocol from the immediate postoperative period through day 7, emphasizing early mobilization, progressive activity, patient education, and discharge preparation.

3.3 Phase 3: Expert Evaluation and Tryout

Based on the evaluation by 11 experts, all four components of the SOH-Care Model were rated at the highest level of appropriateness, as shown in Table 3.

Table 3. Expert Evaluation Results for SOH-Care Model Components (n = 11 experts)

Component	Mean	SD	Rating
Overall Care Model (care process flowchart)	4.55	0.32	Highest
Pre-Anesthetic Evaluation Form (CVT)	4.92	0.21	Highest
Patient Education Leaflet	4.86	0.28	Highest
Competency Assessment Tool (overall)	4.60	0.50	Highest
Pre-preparation phase	4.61	0.48	Highest
Pre-operative phase	4.58	0.51	Highest
Intraoperative phase	4.64	0.49	Highest
Post-operative phase	4.59	0.52	Highest
Discharge phase	4.62	0.49	Highest
ICU CVT Rehabilitation & Discharge Plan (overall)	4.68	0.28	Highest
Day 0 (immediate post-op)	4.73	0.31	Highest
Day 4	4.77	0.29	Highest
Day 6 (pre-discharge)	4.82	0.26	Highest

All four model components achieved mean appropriateness scores between 4.55 and 4.92, with consistently low standard deviations indicating strong consensus among evaluators. The Pre-Anesthetic Evaluation Form (CVT) received the highest rating (mean = 4.92, SD = 0.21), reflecting expert confidence in its clinical comprehensiveness. Across the five phases of the Competency Assessment Tool, mean scores ranged narrowly from 4.58 to 4.64, suggesting that the instrument achieved uniform quality across all care phases rather than concentrating strength in any single domain. The ICU CVT Rehabilitation and Discharge Plan showed a progressively increasing rating from Day 0 to Day 6 (4.73 to 4.82), indicating that experts particularly valued the structured pre-discharge preparation component.

3.4 Phase 4: Outcome Evaluation

3.4.1 Provider Outcomes

The assessment of nursing staff competency before and after implementing the SOH-Care Model (n = 29) revealed that competency scores improved in all five care phases, as shown in Table 4.

Table 4. Nursing Competency Scores Pre- and Post-Model Implementation (n = 29)

Care Phase	Before (%)	After (%)	Change (%)	*p*-value*
Pre-preparation	93.85	96.21	+2.36	< 0.05
Pre-operative	94.10	96.65	+2.55	< 0.05
Intraoperative	95.37	97.32	+1.95	< 0.05
Post-operative	94.88	97.05	+2.17	< 0.05
Discharge planning	96.38	97.66	+1.28	< 0.05
Overall	94.92	96.98	+2.06	< 0.05

*Wilcoxon signed-rank test; significance set at $p < 0.05$.

Competency scores improved across all five care phases following model implementation, with overall compliance advancing from 94.92% to 96.98% (Δ +2.06%, $p < 0.05$). The largest gain was observed in the preoperative phase (Δ +2.55%), while the smallest was in the discharge planning phase (Δ +1.28%), a phase that had the highest baseline score (96.38%), suggesting a ceiling effect in that domain. The statistically significant improvement across all phases indicates a consistent, model-attributable effect rather than random variation. The qualitative findings from Phase 4 (Outcome Evaluation) complement the quantitative results by providing deeper insights into the experiences and perceptions of nursing staff and patients regarding the implementation of the SOH-Care Model. Content analysis of interviews and focus group discussions revealed several key themes.

1) Enhanced Continuity and Systematic Care. Nursing staff reported that the SOH-Care Model facilitated more continuous and systematic care across all phases from pre-preparation to discharge. They highlighted improved adherence to standardized protocols and clearer role definitions, which reduced ambiguity and enhanced confidence in clinical decision-making. Nurses emphasized that the model helped minimize fragmented care and promoted a more integrated multidisciplinary approach.

2) Improved Communication and Team Collaboration. Participants noted that communication within the multidisciplinary team became more structured and effective, particularly through the use of standardized tools such as the pre-anesthetic evaluation form (CVT) and the competency assessment tool. This enhanced information exchange contributed to safer patient transitions between care phases and reduced errors related to miscommunication.

3) Patient Empowerment and Education. Patients and their families expressed appreciation for the clear, accessible information provided through the patient education leaflet and ongoing education during hospitalization. Themes emerged around increased understanding of the surgical process, reduced preoperative anxiety, and greater confidence in self-care after discharge. Patients valued the opportunities to ask questions and felt supported by the healthcare team.

4) Challenges and Areas for Further Improvement. While overall satisfaction was high, nursing staff identified workload and resource constraints as ongoing challenges that could impact the consistent application of the model. Some patients mentioned a need for more tailored education materials to accommodate varying literacy levels and requested enhanced follow-up support after discharge to address lingering concerns.

5) Professional Development and Competency Growth. Nurses reported that the competency assessment tool supported their professional development by clearly outlining expected skills and behaviors across care phases. This structured evaluation encouraged reflective practice and highlighted areas for targeted training, contributing to improved clinical competency and patient safety. A comparison of nursing team satisfaction before and after model implementation using a paired-samples t-test (n = 29) revealed significant improvement in all domains, as shown in Table 5.

Table 5. Nursing Team Satisfaction Before and After Model Implementation (n = 29)

Domain	Before ($\bar{x}$±SD)	After ($\bar{x}$±SD)	Δ	t	*p*-value
Clarity of model and guidelines	4.10 ± 0.45	4.80 ± 0.32	+0.70	6.25	< .001**
Appropriateness of the model	4.05 ± 0.50	4.70 ± 0.36	+0.65	5.89	< .001**
Feasibility of implementation	4.00 ± 0.47	4.65 ± 0.48	+0.65	5.12	0.001**
Overall satisfaction	4.04 ± 0.46	4.68 ± 0.39	+0.64	6.11	< .001***

**$p < 0.01$; ***$p < 0.001$. Paired-samples t-test.

Overall team satisfaction improved significantly from a mean of 4.04 (SD = 0.46) to 4.68 (SD = 0.39), representing a mean gain of 0.64 points ($t(28) = 6.11$, $p < 0.001$). All three domains showed statistically significant improvement at $p < 0.01$. The greatest gain occurred in clarity of model and guidelines (Δ +0.70, $t = 6.25$, $p < 0.001$), which directly corresponds to the structural ambiguity identified as a key problem in Phase 1, suggesting that the model effectively resolved the communication and role-definition deficiencies that staff had previously experienced. The reduction in standard deviation across all domains after implementation (e.g., overall SD: 0.46 ⟶ 0.39) indicates not only higher satisfaction but also greater consistency of experience among nursing staff.

3.4.2 Patient Outcomes — Operational Indicators

Evaluation of patient operational outcomes before and after model implementation (n = 30) showed that all seven operational indicators met their specified targets, as shown in Table 6.

All seven operational indicators reached their specified targets following model implementation. Four indicators that were below target before implementation—preoperative assessment completion, surgery cancellations, emergency assessment timeliness, and HAD management timeliness—all achieved 100% or 0% as required. Notably, postoperative arrhythmia incidence was eliminated, decreasing from 3.33% to 0%, and no 7-day readmissions occurred in either period. The sole indicator that had already achieved its target before implementation—rehabilitation and discharge planning coverage—was maintained at 100%, confirming that the model did not disrupt existing best practices while improving areas of deficiency.

Table 6. Operational Outcome Indicators Before and After Model Implementation (n = 30)

Indicator	Target	Before n (%)	After n (%)
Patients received pre-op assessment by nursing team	100%	29 (96.67%)	30 (100%)
Surgery cancellations due to patient unreadiness	0%	1 (3.33%)	0 (0%)
Emergency assessment reported within 1 min (anesthesia)	100%	29 (96.67%)	30 (100%)
High-alert drug (HAD) management within 1 min	100%	29 (96.67%)	30 (100%)
Post-operative arrhythmia incidents	0%	1 (3.33%)	0 (0%)
7-day readmission incidents	0%	0 (0%)	0 (0%)
Patients received rehabilitation & discharge planning	100%	30 (100%)	30 (100%)

3.4.3 Clinical Outcomes

The incidence of coagulopathy decreased from 100% to 70%. The ICU length of stay in the optimal 8–14-day range increased from 33.33% to 56.67%. No patients required cardiac assist devices after model implementation, compared with 6.7% before implementation. The vasodilator requirement decreased from 80% to 60%. At the one-month follow-up, 100% of patients could walk independently and climb stairs, increasing from 73.33% and 83.34%, respectively, before implementation. No deaths occurred within 30 days of the operation.

Patient satisfaction was high, with an overall mean of 4.70 (SD = 0.47). The highest-rated domains were information received (4.77), equipment care (4.73), and staff attentiveness (4.77). No patient was readmitted or died within 30 days post-discharge. A review of clinical outcome records found that several postoperative complications decreased after model implementation, most notably a 30% reduction in coagulopathy, as shown in Table 7.

Beyond complication reduction, functional recovery outcomes at one-month follow-up were notable: all 30 patients achieved full independence in daily activities, including walking and stair climbing, representing a meaningful improvement over the pre-implementation baseline. Patient satisfaction was high overall (mean = 4.70, SD = 0.47), with information received and staff attentiveness emerging as the most highly rated domains. No patient died or was readmitted within 30 days of discharge.

Table 7. Clinical Outcomes — Complications During Hospitalization (n = 30)

Complication	Before n (%)	After n (%)	Change
Anemia	30 (100%)	30 (100%)	No change
Hypokalemia	30 (100%)	29 (96.67%)	Decreased
Hypocalcemia	30 (100%)	30 (100%)	No change
Coagulopathy	30 (100%)	21 (70%)	↓ 30%
Hypothermia	9 (30%)	13 (43.33%)	Increased
Bradycardia	4 (13.33%)	1 (3.33%)	↓ 10%
Hypomagnesemia	2 (6.67%)	3 (10%)	Slight increase

4. Discussion

4.1 Situation Analysis

The identification of a "Fragmented Holistic Care System" as the overarching structural problem in Phase 1 carries important clinical meaning. It indicates that poor patient outcomes were not attributable to individual professional incompetence, but rather to the absence of system-level coordination mechanisms, specifically unified clinical guidelines, structured handoff protocols, and shared documentation tools across the multidisciplinary team. The resulting 5.88% surgery cancellation rate, while numerically modest, represents a concrete patient safety failure with measurable downstream consequences, including delayed treatment, extended hospital stays, and avoidable psychological distress for patients and families.

This finding is consistent with Sanders et al. (2022), who identified inadequate preoperative risk assessment and fragmented interdisciplinary communication as primary structural drivers of cardiac surgical morbidity and mortality. Similarly, Noor et al. (2024) reported that cardiac complications following non-cardiac surgery remain a major cause of perioperative morbidity and mortality, with urgent surgeries demonstrating a significantly higher incidence of complications compared with elective procedures. A recent meta-analysis reported cardiac complication rates of 5.4% in urgent surgeries and 2.8% in elective surgeries, with urgent procedures associated with a markedly increased risk of adverse cardiac events.

The observed pattern at Sisaket Hospital therefore reflects a systemic challenge well recognized in the international cardiac surgery literature, rather than an isolated institutional failing. The additional finding that nurse burnout and high workload constrained double-check adherence aligns with Moss et al. (2016), who demonstrated that staffing intensity directly limits safety-critical process compliance in specialized nursing environments.

These findings were broadly anticipated given the hospital's relatively recent designation as a Level II Cardiac Surgery Center in 2022, a context in which clinical protocols are typically established before the supporting coordination infrastructure is fully developed. That said, the scale of fragmentation spanning all four identified problem categories simultaneously was more pronounced than initially expected, which underscored the need for a comprehensive model rather than targeted protocol adjustments alone.

4.2 Model Development — The SOH-Care Model

The consistently high expert appropriateness ratings across all four SOH-Care Model components (overall mean range: 4.55–4.92) indicate that the model achieved strong content validity and practical relevance, as judged by specialist clinicians. The particularly high rating for the CVT Pre-Anesthetic Evaluation Form (mean = 4.92, SD = 0.21) is notable, as it suggests that the instrument captured the clinical complexity of pre-anesthetic assessment in a format that experts regarded as both comprehensive and operationally feasible. The slightly lower, though still high, rating for the Competency Assessment Tool (mean = 4.60, SD = 0.50) likely reflects the inherent difficulty of operationalizing multidimensional clinical competencies, particularly interprofessional collaboration, into discrete, assessable items.

These outcomes align with Grant et al. (2023), who demonstrated that structured MDT preoperative assessment frameworks developed through collaborative clinical design significantly reduce unnecessary resource utilization and improve patient outcomes, precisely because they are grounded in the contextual realities of the implementing institution. The Day 0–7 ICU rehabilitation protocol represents a deliberate shift from reactive to proactive nursing care, consistent with ERAS principles as documented by Zhang et al. (2021), whose meta-analysis confirmed that structured early rehabilitation protocols reduce ICU length of stay and postoperative complications in cardiac surgery patients. The empowerment-oriented

patient education leaflet reflects the broader principle that bilingual, accessible cardiac surgery education materials can improve patient self-care adherence and reduce preoperative anxiety.

The high expert ratings were expected given the participatory design methodology; models co-constructed with frontline clinicians and reviewed by domain specialists typically achieve stronger face and content validity than those developed through top-down policy processes alone. This expectation was confirmed.

4.3 Outcome Evaluation

4.3.1 Provider Outcomes

The increase in nursing competency scores across all five care phases, from an overall mean of 94.92% to 96.98%, is clinically meaningful, even though the absolute magnitude of change appears modest. In high-acuity surgical nursing, performance in safety-critical behaviors is already constrained near ceiling levels by professional regulation and existing protocols; consequently, even small percentage gains reflect substantive improvements in systematic compliance rather than basic skill acquisition. Phase-level Wilcoxon signed-rank testing confirmed that these improvements were statistically significant across all phases ($p < 0.05$), indicating a consistent rather than incidental effect of model implementation.

The significant improvement in team satisfaction ($t(28) = 6.11$, $p < 0.001$, Δ +0.64) is particularly important because satisfaction among specialist nursing staff is a recognized leading indicator of sustained protocol adherence and staff retention in high-demand clinical environments. The domain showing the largest gain, clarity of model and guidelines (Δ +0.70), directly reflects the resolution of the structural ambiguity identified in Phase 1, confirming that the model addressed the root cause of the problem rather than its symptoms. This pattern is consistent with prior evidence that implementation of structured interdisciplinary care planning in cardiac surgery settings produced significant and durable improvements in both outcomes and staff satisfaction, particularly where clear role definition had previously been absent.

4.3.2 Patient Outcomes — Operational and Clinical Indicators

The achievement of all seven operational indicator targets represents the most direct evidence of the model's practical effectiveness. The transition from 96.67% to 100% in preoperative assessment completion, and the elimination of surgery cancellations due to patient unreadiness, confirms that the structural integration achieved through the SOH-Care Model translated into measurable patient safety gains. These findings align with Kaneko et al. (2023), who demonstrated that structured MDT preoperative pathways for high-risk cardiac surgery patients are the single most effective intervention for reducing avoidable cancellations and operative complications.

The 30% reduction in coagulopathy incidence, from 100% to 70%, is a clinically significant finding. While some degree of coagulopathy is an expected consequence of cardiopulmonary bypass due to hemodilution, platelet activation, and clotting factor consumption, the reduction observed here is consistent with Mutsuga M. (2023), who demonstrated that optimized operative duration management and perioperative monitoring protocols, both of which are central elements of the SOH-Care Model's intraoperative and postoperative phases, substantially mitigate coagulopathy severity.

Despite the overall improvement in other outcomes, hypothermia increased from 9/30 (30%) to 13/30 (43.33%), whereas hypomagnesemia increased from 2/30 (6.67%) to 3/30 (10%). These findings represent increases of four and one cases, respectively, and should be interpreted cautiously because each comparison group comprised only 30 patients and the study was not designed or powered to determine the causes of individual complications. Possible explanations include differences in operative

complexity or cardiopulmonary bypass duration, changes in the sensitivity of monitoring and documentation, and variation in perioperative warming or magnesium replacement practices; however, these factors were not measured systematically. Accordingly, the increases cannot be attributed to the SOH-Care Model. Future prospective studies with larger samples should use standardized definitions and collect risk-adjustment variables, including procedure type and complexity, bypass and cross-clamp times, serial core-temperature measurements, magnesium concentrations, and replacement therapy.

The finding that 100% of patients recovered full functional independence within one month of discharge, including independent walking and stair climbing, exceeds the preoperative baseline of 73.33% and 83.34%, respectively, and is consistent with Alvarez et al. (2020), who demonstrated that structured nurse-led rehabilitation beginning in the immediate postoperative period significantly accelerates cardiovascular recovery and reduces pulmonary complications. The zero 30-day mortality and readmission rates, while favorable, should be interpreted cautiously given the small sample size and the relatively short follow-up window.

It should be noted that the improvements observed across all outcome domains cannot be attributed exclusively to the SOH-Care Model. The absence of a concurrent control group means that concurrent changes in staffing experience, surgical caseload maturation, or broader institutional quality improvement activities may have contributed to the results. These findings are therefore best interpreted as indicative of the model's potential value within this specific institutional context, pending validation in controlled or multi-site studies.

5. Conclusion and suggestions

5.1 Conclusion

Open-heart surgery nursing in provincial tertiary hospitals demands a level of system-wide coordination that informal, role-based practice alone cannot sustain. This study addressed that gap by developing and evaluating the SOH-Care Model—a four-component, evidence-based nursing care model grounded in the ASPIRE framework and constructed through genuine multidisciplinary collaboration at Sisaket Hospital.

The model successfully fulfilled each of its three research objectives. First, situation analysis confirmed that fragmented care integration, rather than individual professional competence, was the primary structural barrier to consistent patient safety outcomes. Second, the development process produced a coherent set of clinical tools—the CVT pre-anesthetic evaluation form, patient education leaflet, competency assessment tool, and ICU rehabilitation and discharge plan—each achieving expert appropriateness ratings at the highest level (overall mean = 4.60, SD = 0.50). Third, outcome evaluation demonstrated that model implementation yielded measurable improvements across all dimensions: nursing competency scores advanced across all five care phases, team satisfaction improved significantly ($t(28) = 6.11$, $p < 0.001$), all seven operational indicators reached their targets, and coagulopathy incidence decreased by 30%, with 100% of patients recovering full functional independence within one month of discharge.

Taken together, these findings indicate that the SOH-Care Model addressed the identified research problem and met the study's anticipated outcomes within the scope of a single-site, pre–post design. The significance of these results extends beyond operational performance metrics: they demonstrate that standardized, multidisciplinary nursing care—when co-designed with frontline staff and validated by clinical experts—can meaningfully reduce system-level fragmentation and strengthen patient

safety in a resource-constrained provincial setting. For nursing practice, the model offers a replicable framework for cardiac surgery care development; for the broader field, it contributes an empirically evaluated prototype for constructing competency-aligned, phase-specific nursing care models in complex surgical contexts. Multi-site validation across comparable provincial hospitals is recommended as the logical next step toward national-level implementation.

5.2 Suggestions for Future Research

1) Health economic evaluation: Compare the cost-effectiveness of the developed model versus standard care for hospital resource allocation decisions.

2) Long-term patient-reported outcomes: Extend the assessment to 6–12 months post-discharge to evaluate quality of life, physical function, and psychological outcomes, including anxiety and depression.

3) National standardized competency development: Develop a nationally standardized competency framework for Thai nurse anesthetists in open-heart surgery, using this model as a prototype.

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