

A Study on the Development of Quality Indicators for Perioperative Care of Lung Cancer Patients Using the Structure-Process-Outcome Framework

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Abstract: This study chose to use the Structure-Process-Outcome (SPO) framework to clarify the approach taken to developing indicators for assessing the quality of the perioperative nursing care for patients with lung cancer. Combining the ERAS guidelines for lung surgery, the literature on perioperative quality management, and the results from the research on nursing sensitive indicators, the dimensional classification, the source of items, and the application pathways of the nursing sensitive quality indicators for the perioperative period of lung cancer patients were analyzed. According to the literature, key items in the evaluation of the quality of nursing care for lung cancer patients in the perioperative period are respiratory training, pain assessment, observation of the chest drainage, early mobility and monitoring of pulmonary complications. Based on actual examples, a data-based evaluation system that emphasizes process indicators, takes outcome indicators as calibration, and takes structure indicators as support is recommended to increase the operativeness of thoracic surgery specialty nursing quality management.

Keywords: Structure-Process-Outcome; Lung Cancer; Perioperative Nursing; Nursing-Sensitive Indicators

1. Introduction

Perioperative management for lung cancer surgery includes the respiratory preparation, pain management, chest drainage, early mobilization and prevention of complications, which all affect the recovery process after surgery. In general nursing quality indicators, the emphasis is placed on simple nursing care, documentation and satisfaction with the patients, which makes it difficult to depict the particular risks in

perioperative care of patients with a lung cancer. The Structure-Process-Outcome framework is proposed as suitable to stratify Nursing Quality Indicators into three types: structure, process and outcome. An evaluation framework that includes nursing resources, key nursing interventions and patient outcomes can be developed by focusing on nursing-sensitive outcomes of patients who undergo lung cancer surgery and incorporating the ERAS (Enhanced Recovery After Surgery) concept with the research on nursing-sensitive indicators. The Agency for Healthcare Research and Quality (AHRQ) explicitly divides healthcare quality indicators into three types-structure, process and outcome, which is the foundation of the framework of this study [1].

2. Development of a System of Nursing-Sensitive Indicators for Perioperative Lung Cancer Care

2.1 Theoretical Framework and Dimension Classification

The structure-process-outcome paradigm can be used in the construction of a system of nursing-sensitive indicators for quality care of lung cancer patients during surgery[2]. The structure dimension emphasizes the basic requirements for nursing quality, such as thoracic surgery specialty nurses, training in pathway to care for lung cancer, the equipment available for lung rehabilitation, pain assessment tools, rules for chest tube management, and computer system for data collection. The process dimension addresses the application of nursing interventions, including pre opioid surgery pulmonary function assessment, pre- and post-operative risk assessment, respiratory training and education, dynamic postoperative pain assessment, observation and documentation of chest drainage, VTE prevention, early

ambulation and post-discharge follow-up. The outcome dimension targets patient safety and rehabilitation outcomes, such as the incidence of postoperative pulmonary complications, the percentage of patients achieving pain control targets, the incidence of unplanned extubation, the average postoperative length of stay, the 30-day rate of unplanned readmission and the satisfaction of nursing.

2.2 Development of Nursing-Sensitive Indicator Items

The items for nursing-sensitive indicators were primarily derived from the ERAS guidelines for lung surgery, literature on perioperative care in thoracic surgery, studies on nursing-sensitive indicators, and clinical nursing pathways. The ERAS guidelines for lung surgery, published by the ERAS Society and the European Society of Thoracic Surgeons, provide recommendations for optimizing the perioperative period in thoracic surgery and can serve as the basis for establishing indicators such as respiratory training, pain management, early mobilization, and complication prevention. Selected items must meet the following requirements: they must be directly related to perioperative care for lung cancer, reflect nursing interventions or outcomes, have traceable data sources, and have clearly defined numerators and denominators. For rate-based indicators, a standardized calculation method may be adopted:

$$R_i = \frac{N_i}{D_i} \times 100\% \quad (1)$$

Where R_i is the value of the nursing-sensitive quality indicator for item i ; N_i is the number of cases or events meeting the indicator requirements; and D_i is the number of applicable cases during the same period [3].

2.3 Indicator Screening Method and Approach to Determining Weights

Since systematic reviews do not directly present the results of completed Delphi consultations, the Delphi method can be recommended as a pathway for indicator selection. The expert panel should cover fields such as thoracic surgery nursing, oncology nursing, nursing quality control, nursing management, and evidence-based nursing. Scoring criteria include importance, nursing sensitivity, feasibility, and data collectability. A systematic review on nursing-sensitive indicators indicates that these

indicators can be used to evaluate the quality of nursing services and promote indicator standardization, thereby supporting the establishment of a comparable and traceable indicator system for the evaluation of nursing quality in specialized disease care. Expert authority can be evaluated according to Equation (2):

$$C_r = \frac{C_a + C_s}{2} \quad (2)$$

where C_r is the expert authority coefficient; C_a is the basis-for-judgment coefficient; and C_s is the familiarity coefficient. The degree of consensus among experts can be evaluated using Equation (3):

$$CV_i = \frac{S_i}{\bar{x}_i} \quad (3)$$

Where CV_i is the coefficient of variation for the i th indicator; $\frac{S_i}{\bar{x}_i}$ is the standard deviation of expert scores; and $\bar{x}_i$ is the mean of expert scores [4].

2.4 Structure of Core Indicators and Evaluation Focus

The AHP method can serve as a tool for determining the weights of sensitive quality indicators in perioperative lung cancer nursing. After establishing a hierarchical structure comprising the goal level, criterion level, and indicator level, experts use a 1-9 rating scale to conduct pairwise comparisons of indicators at the same level, forming a judgment matrix. Weights are then calculated using the geometric mean method:

$$W_i = \frac{\left(\prod_{j=1}^n a_{ij} \right)^{1/n}}{\sum_{i=1}^n \left(\prod_{j=1}^n a_{ij} \right)^{1/n}} \quad (4)$$

where W_i is the weight of the i th indicator; a_{ij} is the importance value assigned in the judgment matrix to the i th indicator relative to the j th indicator; and n is the number of indicators at the same level [5].

To avoid logical contradictions in the experts' judgments, consistency checks are performed on the judgment matrices at each level, using the following formula:

$$CI = \frac{\lambda_{\max} - n}{n-1}, CR = \frac{CI}{RI} \quad (5)$$

Where: CI is the consistency index; $\lambda_{\max}$ is the largest eigenvalue of the judgment matrix;

n is the order of the judgment matrix; RI is the random consistency index; and CR is the consistency ratio. A review and synthesis indicate that the evaluation of perioperative nursing quality for lung cancer should emphasize process indicators and use outcome indicators to calibrate the effectiveness of nursing interventions. The core indicator structure is shown in Table 1.

Table 1. Core Structure of Nursing-Sensitive Quality Indicators

Dimension	Core Indicator	Evidence Focus
Structure	Specialist Nurse Allocation	Staffing support
Structure	Nursing pathway training	Protocol implementation
Structure	Respiratory rehabilitation equipment	Pulmonary recovery support
Process	Respiratory Training Education	ERAS-based preparation
Process	Pulmonary function/risk assessment	Perioperative risk screening
Process	Dynamic pain assessment	Coughing and Mobilization Support
Process	Chest Drainage Monitoring	Tube safety management
Process	Early ambulation	Accelerated recovery
Process	VTE Prevention	Perioperative Safety
Outcome	Pulmonary complications	Major postoperative outcome
Outcome	Unplanned extubation	Tube-related safety outcome
Outcome	Postoperative length of stay	Recovery efficiency
Outcome	30-day unplanned readmission	Continuity-of-care outcome

3. Application Pathway for the Sensitive Indicator System for Perioperative Care of Lung Cancer

3.1 Data Sources and Collection Criteria for Indicators

Data sources for perioperative nursing sensitivity indicators for lung cancer should primarily include the hospital information system, electronic medical records, nursing records, pain assessment forms, chest drainage records, rehabilitation exercise records, and follow-up systems. Structural indicators are mainly derived from staff schedules, training records, equipment ledgers, and nursing protocols; process indicators are primarily derived from nursing records, health education records, pain score

records, tube observation records, and rehabilitation activity records; outcome indicators are primarily derived from discharge summaries, complication registries, adverse event registries, and 30-day follow-up records. Data collection points may be set at within 24 hours of admission, 1 day preoperatively, 24-72 hours postoperatively, prior to discharge, and 30 days post-discharge. Missing data must not be treated as meeting the standard; negative indicators must be cross-verified against medical diagnoses, adverse event registries, and follow-up records[5].

3.2 Literature Evidence Supporting Core Process Indicators

Core process indicators should be designed around nursing interventions that are modifiable, recoCore process indicators should be related to an intervention that is modifiable, recordable and traceable in relation to nursing. Respiratory training and education are used to enhance coughing and clearance of sputum, and therefore to prepare for recovery of lung function, observation of chest drainage relates to fixation of the tube, drainage of the chest without obstruction and the identification of abnormalities, and early mobilisation is a key process indicator for recovery after lung resection. Studies of early mobilization have shown that postoperative pulmonary complications can be prevented by early mobilization after lung resection, and postoperative recovery outcomes (bowel function recovery, early chest tube removal) were associated with getting out of bed within 24 hours. Prevention of VTE, follow-up after discharge and continuity of care are examples of perioperative safety management and continuum of care in post-discharge rehabilitation.

3.3 Outcome Measures and Quality Assessment Methods

Outcome indicators should be selected based on outcomes that can be influenced by nursing interventions, have clear clinical significance, and for which data can be traced. These include the incidence of postoperative pulmonary complications, the incidence of unplanned extubation, length of postoperative hospital stay, the 30-day unplanned readmission rate, and patient satisfaction with nursing care. Since different indicators may have inconsistent measurement scales, they must be standardized

before comprehensive evaluation:

$$NQI = \sum_{i=1}^m W_i S_i$$

$$S_i = \begin{cases} \frac{X_i}{T_i} \times 100, & i \in P \\ \left(1 - \frac{X_i}{T_i}\right) \times 100, & i \in N \end{cases} \quad (6)$$

Where: NQI is the comprehensive index of primary literature sources for core indicators.

perioperative nursing quality for lung cancer; W_i is the weight of the i th indicator; S_i is the standardized score; X_i is the actual value; T_i is the target value; P and N represent the sets of positive and negative indicators, respectively. Table 2 lists the

Table 2 Evidence Sources for Core Nursing-Sensitive Indicators

Indicator	Main Evidence Source	Data Source Type
Structure/process/outcome classification	Donabedian model, AHRQ quality measure classification	Quality framework
Respiratory training and education	ERAS Society/ESTS Lung Surgery Guideline	Guideline evidence
Dynamic pain assessment	ERAS Perioperative Lung Surgery Care Literature	Guideline/Literature Evidence
Chest Drainage Monitoring	Perioperative Thoracic Nursing Literature	Clinical pathway evidence
Early ambulation	Studies on early ambulation following lung resection	Clinical research evidence
Pulmonary complications	Literature on ERAS and postoperative outcomes in lung surgery	Outcome evidence
Postoperative Length of Stay	ERAS in lung surgery: Literature	Evidence on recovery outcomes
30-day unplanned readmission	Perioperative quality evaluation literature	Evidence on continuity of care

3.4 Data-Driven Management and Continuous Improvement

Sensitive quality indicators for perioperative lung cancer care can be incorporated into the thoracic surgery department's monthly quality control process. The nursing quality control team should regularly compile structural, process, and outcome data to calculate the compliance rate for individual indicators, the incidence of adverse events, and a comprehensive quality index. High-weighted indicators should be prioritized for early warning management, with a focus on pulmonary complications, chest tube drainage monitoring, respiratory exercises, pain assessment, and early mobilization. Abnormal indicators should be attributed to factors including lack of pain management, chest tube fixation which limits mobility, failure to educate patients early on, inconsistent assessment of contraindications for mobility, and patient's lack of adherence. Indicators that show low compliance rates across the board or have frequent abnormalities may be targeted in special quality control programs that involve reviewing and discussing the data, revising the process, and monitoring the results.

4. Conclusion

Building a sensitive quality indicator system for perioperative lung cancer nursing from the

perspective of structure-process-outcome can help integrate the disease-specific nursing risks, key nursing processes and patient outcomes into a comprehensive evaluation system. Based on literature review, the results have shown that the main components of the evaluation of lung cancer nursing quality in the perioperative period are respiratory training, pain evaluation, chest drainage observation, early activity and pulmonary complication monitoring. Future research could make use of the multicenter clinical data to carry out indicator screening, weight calibration and dynamic threshold validation, and further improve the clinical applicability of the indicator system.

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