

# Construction of a Standardized Management System for VTE in Elderly Stroke Patients based on a Nursing Quality Improvement Project

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**Abstract:** Aiming at the weak links in the prevention and management of venous thromboembolism (VTE) in elderly stroke patients, a standardized VTE management system was constructed based on a nursing quality improvement project. By adopting multidisciplinary collaboration, comprehensive evidence-based evidence, and PDCA cycle methods, it deeply integrated the particularities of geriatric medicine and the pathological and physiological changes after stroke, breaking through the limitations of traditional single-dimensional nursing. A closed-loop management system was formed, consisting of six modules: organizational management, standardized risk assessment, graded prevention strategies, path-based health education, information support systems, and quality control and continuous improvement. This system is prevention-oriented and evidence-driven, aiming to achieve homogeneity and high quality in VTE protection, providing a scientific and operational theoretical framework for clinical practice and promoting the continuous improvement of nursing quality.

**Keywords:** Elderly; Stroke; Venous Thromboembolism; Nursing Quality Improvement; Standardized System

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## 1. Introduction

Stroke is a common critical illness in clinical practice, with a high incidence rate among the elderly population<sup>[1]</sup>. Venous thromboembolism (VTE) is a common and dangerous complication after cerebrovascular surgery. According to statistics, stroke patients are at high risk of VTE. If not intervened properly and effectively, the probability of VTE in stroke patients is 30% to 40%, and the incidence rate of VTE in patients with long-term bedridden due to loss of self-care ability is 60% to 75%<sup>[2]</sup>. Elderly stroke patients are often at extremely high risk of VTE due to consciousness disorders, limb paralysis, long-term bedridden, vascular endothelial injury, hypercoagulable state of blood, and age-related venous wall degenerative changes. Once VTE occurs, the difficulty of treatment and mortality rate are significantly higher than those of young patients, so it requires special attention. VTE includes deep vein thrombosis and pulmonary embolism<sup>[3]</sup>. Once it occurs, it not only significantly increases the patient's suffering, prolongs the hospital stay, and increases the economic burden, but also directly threatens the patient's life. However, currently, VTE is often prevented through combined prevention or simple mechanical prevention in clinical practice<sup>[4]</sup>. There are still many weak links in the prevention and management of VTE in elderly stroke patients, such as inconsistent risk assessment tools, untimely risk stratification, low compliance with preventive measures, incomplete multi-disciplinary collaboration mechanisms, and lack of age-specific health education. This leads to uneven

quality of VTE protection among different institutions and wards. How to build a scientific, standardized, and operable VTE management system through systematic means has become an urgent clinical nursing problem to be solved.

In recent years, nursing quality improvement projects, as an important method for enhancing clinical care levels, have been widely introduced into nursing management practices. Nursing quality improvement projects aim to center on the physical and mental health of patients, based on evidence, continuously explore the deficiencies in clinical work, apply scientific thinking methods, improve the patient's medical experience, and enhance the quality of care. Through scientific measurement methods, sufficient evidence is used to prove the actual effects of the improvement projects<sup>[5]</sup>. Applying nursing quality improvement projects to the VTE management of elderly stroke patients can systematically identify loopholes, integrate cutting-edge evidence, break professional barriers, and form a dynamic improvement management loop. Although some studies have explored bundled measures or risk prediction models for VTE prevention in stroke patients<sup>[6-8]</sup>, most of them focus on a single aspect and have not established a comprehensive and standardized system that deeply integrates risk assessment, stratified prevention, health education, information-based early warning, and quality evaluation feedback. In particular, there is still a lack of consideration for the complex issues of elderly patients, such as multiple comorbidities, cognitive decline, and special drug tolerance. Therefore, based on nursing quality improvement projects, this study attempts to construct a standardized VTE management system covering the entire process and multiple dimensions for elderly stroke patients, with the aim of providing a theoretical framework and practical guidance for clinical practice and promoting the homogenization and high quality of VTE protection.

## 2. System Construction Method

The construction of this system is based on the framework of the nursing quality improvement project, adhering to the three-dimensional quality theory of structure, process, and outcome, and comprehensively applying evidence-based methodology and the concept of continuous quality improvement to advance step by step.

### 2.1 Formation of a Multidisciplinary Collaboration Team

Led by the Nursing Department, a multidisciplinary VTE management team was formed by joining forces with professionals from the Neurology Department, Geriatrics Department, Rehabilitation Medicine Department, Vascular Surgery Department, Pharmacy Department, and Information Technology Department. The responsibilities of each member were clearly defined: nurses were responsible for initial risk screening, implementation of preventive measures, and health education; physicians were responsible for risk assessment confirmation, issuance of preventive and treatment orders; pharmacists provided individualized medication advice; rehabilitation therapists developed early activity plans; and IT engineers were responsible for the development and maintenance of information modules. The team established a regular communication and consultation mechanism for difficult cases, providing organizational support for the system construction.

### 2.2 Current Situation Analysis and Key Problem Identification

Using flowchart and root cause analysis methods, a complete value stream map was drawn from patient admission, disease progression, order issuance to nursing execution. Combining the concept of comprehensive geriatric assessment, we further conducted a detailed review of the current VTE management process for elderly stroke patients. Through a step-by-step review of each link, including admission assessment, issuance of preventive orders, nursing execution, disease monitoring, and discharge follow-up, the weak points affecting the management quality were identified, including: delayed or missed risk screening, non-standard use of physical prevention equipment, overly conservative or aggressive anticoagulation regimens, excessive concerns of elderly patients and their families about early activities, inappropriate health education methods for the elderly, and lack of real-time early warning and quality control loops. These key issues became the sources of evidence retrieval and system construction.

### 2.3 Evidence Retrieval and Synthesis

Focusing on the key issues, a systematic search was conducted for the best practice guidelines, evidence summaries, systematic reviews, and expert consensus related to VTE prevention in stroke and elderly patients both domestically and internationally. Using recognized evidence quality evaluation tools, the included literature was strictly screened and graded, and high-quality recommendations applicable to elderly stroke patients were extracted. The key contents such as risk

factors, prevention strategies, drug selection and monitoring, indications and contraindications of physical prevention, health education elements, and quality evaluation indicators were integrated to form a structured evidence summary, providing a scientific basis for the drafting of the system.

### **2.4 Drafting of the System and Expert Argumentation**

Based on the evidence summary and problem list, a framework for a standardized management model and corresponding standardized processes were initially drafted. Subsequently, through multiple rounds of expert consultation, multidisciplinary experts with rich experience in the treatment of elderly stroke and nursing management were invited to review each item of the draft in terms of completeness, scientificity, and clinical operability. According to the expert feedback, the model structure, measure details, and execution forms were continuously revised until the expert opinions tended to be consistent, and the final content of the model was determined. The entire establishment process demonstrated the systematic planning in the “planning” stage of the nursing quality improvement project.

## **3. Standardized Management System for VTE in Elderly Stroke Patients**

The constructed system consists of six modules, which are interconnected and work in synergy to form a closed-loop management.

### **3.1 Organizational Management System**

Establish a three-level management structure consisting of the hospital, departments, and wards. At the hospital level, a VTE management committee is established, whose functions include formulating relevant regulations, reviewing quality indicators, and conducting supervision. At the department level, a VTE prevention team is formed, which is responsible for training, quality control, organizing key case discussions, and ensuring the implementation of standardized operations such as assessment, prevention, and education. In the ward, the responsible nurses are responsible for implementing the assessment, prevention, and education procedures. Based on this structure, a multidisciplinary consultation process is integrated to ensure that complex elderly cases can quickly receive support from vascular surgery, pharmacology and other specialties. Through clear hierarchical responsibilities and communication paths, VTE protection is integrated into the daily nursing process.

### **3.2 Standardized Risk Assessment**

Standardize the timing of risk screening for elderly stroke patients during their admission process. Conduct the first assessment in the early stage of admission, and perform dynamic re-evaluation when there are changes in the condition, after surgery, or during transfer to another department. Select validated VTE risk assessment tools that are suitable for the elderly stroke population, taking into account both general internal medicine factors and stroke-specific indicators, and divide patients into low-risk, moderate-risk, high-risk, and extremely high-risk categories. The assessment results are entered into the electronic medical record system, supplemented by automatic coloring identification and warning prompts to prevent human errors, converting rigid data into intuitive clinical decision support. The system introduces a dynamic weight algorithm, automatically increasing the risk level for elderly patients who are elderly ( $\geq 75$  years old), have a history of VTE, or have a malignant tumor. For elderly patients with cognitive impairment or aphasia, the assessment form adds a module for family members to assist in filling in the information, ensuring the completeness of the information, and triggering a high-level warning for extremely high-risk patients at the earliest possible time upon admission. It is stipulated that the bleeding risk assessment is carried out simultaneously, through a comprehensive judgment of coagulation function, liver and kidney function, concurrent medications, and previous bleeding history, providing dual-dimensional support for subsequent prevention decisions.

### **3.3 Stratified Prevention Strategy**

Based on risk stratification, a classification plan combining basic prevention, physical prevention, and drug prevention is formulated. All patients implement basic prevention, including maintaining adequate fluid intake, avoiding dehydration, guiding and assisting in early passive joint movement and ankle pump exercises, and gradually promoting out-of-bed activities. For medium-risk and above patients, if there are no contraindications, physical prevention is initiated as soon as possible, and gradient pressure stockings or intermittent pneumatic compression devices are applied in a standardized manner, with clear application conditions and termination criteria. For high-risk and extremely high-risk patients, after carefully

assessing the bleeding risk, drug prevention is combined according to medical advice, prioritizing anticoagulant drugs with evidence for elderly use, and formulating individualized medication monitoring plans. A prevention measure execution checklist is designed, and the responsible nurse checks and signs each item daily to ensure the implementation of each measure.

### **3.4 Path-based Health Education**

Based on the cognitive characteristics and acceptance habits of elderly patients, a phased and multi-form health education path is designed. In the early stage of admission, the risk and importance of VTE prevention are briefly informed through visual cards; during the acute phase, bedside ankle pump exercises and the correct use of physical prevention devices are taught, and the understanding level is verified through the feedback method; during the recovery phase, sitting up, standing, and walking training are gradually guided, and the benefits and safety boundaries of early activities are explained; before discharge, continuous guidance is provided, including home limb activities, standardized medication use, and identification of abnormal symptoms. At the same time, family members are educated in a standardized manner, and special educational manuals with rich illustrations are distributed. A health education record sheet is also established to track the awareness rate.

### **3.5 Information Support System**

A VTE intelligent early warning and auxiliary decision-making module is constructed within the hospital information system. By real-time extraction of risk assessment fields and nursing record data, the system automatically identifies overdue or delayed assessments and measures and issues pop-up reminders. The nurse workstation is embedded with a knowledge base of preventive measures and operation videos for easy and immediate access. A dedicated quality indicator database for VTE is established to automatically collect process indicators such as assessment rates and implementation rates of preventive measures, as well as outcome data such as VTE event reports, generating visual trend charts to provide real-time and objective information support for routine quality control and continuous improvement.

### **3.6 Quality Control and Continuous Improvement**

A three-tier quality control mechanism is established using the PDCA (Plan-Do-Check-Act) cycle. Quality indicators for VTE prevention nursing are developed covering the structure, process, and outcome dimensions, including the timely rate of risk assessment, accuracy rate of graded prevention, effective implementation rate of preventive measures, awareness rate of health education, and VTE reporting rate. A three-tier quality control model is implemented, consisting of daily self-checks by responsible nurses, weekly inspections by departmental quality control teams, and monthly comprehensive audits by the Nursing Department. For quality control results, quality management tools such as Pareto charts and fishbone diagrams are used to analyze defects and identify root causes. Regular multidisciplinary quality feedback meetings are held to develop targeted improvement plans and track their implementation, thereby incorporating the results of problem-solving into the next PDCA cycle and achieving a spiral upgrade in management quality. At the same time, a non-punitive adverse event reporting system is promoted, encouraging in-depth root cause analysis for every VTE event. A repository of typical VTE prevention cases is established, and regular retrospective learning sessions are organized to facilitate iterative improvement of the system itself.

## **4. Discussion**

This study, based on the nursing quality improvement project as the methodological cornerstone, has constructed a multi-dimensional closed-loop management system for VTE in elderly stroke patients. The overall framework of this system embodies the core concepts of prevention first, evidence-driven, multi-disciplinary integration, and continuous optimization. Compared with the previous fragmented and linear management approaches, this system focuses on breaking down the barriers between risk assessment, stratified intervention, health education, intelligent assistance, and quality monitoring, transforming isolated operations into organic connections, and providing a systematic model for VTE prevention in elderly stroke patients. Especially when dealing with the complex medication history of elderly patients, the team can precisely identify potential drug-disease interactions (such as the increased bleeding risk from the combination of anticoagulants and non-steroidal anti-inflammatory drugs) based on pharmacological monitoring data, thereby formulating the most appropriate personalized thrombosis prevention plans. This cross-professional deep integration not only strengthens the bottom line of

medical safety but also effectively addresses the practical pain points of “daring not to prevent” and “not knowing how to prevent” in clinical practice.

The nursing quality improvement project inherently possesses the attribute of continuous self-optimization. By integrating it into the system design, VTE management is no longer a one-time revision of the system, but a dynamic process of continuous improvement. Through the PDCA cycle, clinical defects can be promptly identified, evidence-based information can be rapidly transformed, and the effectiveness of measure implementation can be verified in real time. This fundamentally promotes the transformation of VTE management from an empirical model to a scientific and lean model. The multidisciplinary team collaboration effectively responds to the complexity of elderly patients: neurologists control stroke conditions, pharmacists precisely assess anticoagulation risks, rehabilitation therapists scientifically formulate activity plans, making the prevention plan both individualized and collaborative, avoiding management blind spots caused by single-person efforts.

The introduction of the information module integrates assessment reminders, measure push, and quality control data cleaning, significantly reducing human delays and enhancing the nurses' compliance with execution through visual feedback. The system can also automatically generate monthly reports on VTE management for the department, facilitating managers to precisely identify weak links. The health education path designed for the elderly group emphasizes simplicity, repetition, multi-sensory stimulation, and family linkage, which is in line with their memory and comprehension decline characteristics, and is conducive to improving the cooperation of patients and their families, shifting from passive acceptance to active participation. In addition, the three-level quality control and root cause analysis mechanism constructed by the quality control module can provide a structured driving force for the continuous calibration of management measures.

However, this system still has certain limitations. Elderly stroke patients often face a difficult balance between bleeding risk and thrombosis risk. Even with stratified plans, clinical decision-making still requires highly individualized judgment; the construction of information systems has certain requirements for the basic conditions of medical institutions, and may encounter resistance in resource-poor environments; the effect of health education is greatly influenced by the fluctuation of patients' cognitive levels, requiring more time and patience from nursing staff. In addition, this system is currently still in the theoretical construction stage, and its implementation effect, parameter quantification of each module, cost-effectiveness, etc., still need to be verified and optimized through multi-center empirical research in the real world. In the future, intelligent decision support algorithms can be further developed, the management characteristics of elderly subgroups can be refined, and the system can be pushed towards a more precise and intelligent direction.

## 5. Conclusion

The standardized management model for VTE in elderly stroke patients is established based on the nursing quality improvement project. It follows a closed-loop management approach, with evidence-based practice at its core and multidisciplinary collaboration as its support. This model integrates six major modules: organizational management, standardized risk assessment, graded prevention, path-based health education, information-based early warning, and three-level quality control. It can systematically address the complex challenges of VTE prevention in the elderly stroke population. This model provides a scientific and operational theoretical framework for clinical VTE management, which is expected to promote the homogeneous implementation of protective measures, continuously improve the quality of care, and particularly emphasizes respect for and adaptation to the individual differences of elderly patients. In the future, its effectiveness should be verified in clinical practice and continuously iterated and improved to achieve efficient, safe, and humanized prevention and control of VTE risks in elderly stroke patients.

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## Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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