

Research Article

# Construction of Training Curriculum System for Venous Thromboembolism (VTE) Liaison Nurses

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## Abstract

**Objective** To construct a training curriculum system for venous thromboembolism (VTE) liaison nurses and provide a basis for corresponding clinical training, evaluation and certification. **Methods** Analyzed the training needs of VTE liaison nurses. Conducted two rounds of Delphi surveys with 27 experts from Hubei, Sichuan, Guizhou, Guangxi and Guangdong provinces in China. Determined the weights of indicators at all levels using the Analytic Hierarchy Process (AHP) and equal weighting method. **Results** The age of the participants ranged from 38~59 ( $46.63 \pm 5.343$ ), and the years of working ranged from 12~42 ( $25.48 \pm 7.439$ ). 27 and 26 valid questionnaires were collected respectively from the first and second rounds of the surveys. The effective response rates of the two-round Delphi survey were 90.0% and 96.3%, respectively, and the experts' authoritative coefficients were 0.884 and 0.906, respectively, and Kendall's coefficient of concordance of experts' opinions were 0.261 and 0.276, respectively ( $P < 0.01$ ). A training system with 5 first-level indicators and 26 second-level indicators was finally formed after two rounds of Delphi surveys. **Conclusions** The training system for VTE liaison nurses constructed in this study is highly scientific and practical, which can provide a basis for the training assessment and ability evaluation of VTE liaison nurses, and also provide a reference for VTE prophylaxis, treatment and nursing.

## Keywords

Venous Thromboembolism, Liaison Nurses, Curriculum System, Delphi Method

## 1. Introduction

Venous thromboembolism (VTE), including deep vein thrombosis (DVT) and pulmonary thromboembolism (PTE) [1], has become the third largest vascular disease in the world and the leading cause of unexpected deaths in hospitals [2]. Surveys conducted in 32 countries have indicated that 40% to 60% of inpatients are at high risk of VTE but only half of them are provided with proper interventions. Yet the situation in China is even worse, with less than 10% of patients receiving VTE prevention, mainly due to the lack of awareness and

practice of VTE risk assessment [3, 4]. In view of the above situation, China has incorporated VTE management into the hospital quality management system and has included "improving the standard prevention rate of venous thromboembolism" into the "National Medical Quality and Safety Improvement Goals" for three consecutive years.

According to substantial guidelines and expert consensus [4-8], it is clear that nurses, who are responsible for monitoring patients' conditions and delivering health education,

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play an essential role in VTE prevention and treatment. Therefore, they should receive scientific and systematic training on VTE prophylaxis. Among them, liaison nurses are nurses who aid the communication between patients and care professionals and are professionally trained in specialized knowledge and skills. They can not only help improve nursing service quality but also act as a professional guide for the department staff to standardize specialized nursing skills within the hospital [9, 10]. The main duties of VTE liaison nurses are VTE risk assessment, prevention, treatment and nursing. They work in various departments in the hospital and play an important role in standardizing VTE nursing and improving VTE prophylaxis and management.

However, studies [11] suggest that the performance of VTE liaison nurses in China requires much improvement due to the lack of relevant training and the absence of assessment and evaluation systems. Since there is little research on standardized training systems for VTE liaison nurses in China, this study is designed to construct a systematic training curriculum system with Delphi method after referring to relevant practice standards and guidelines, and determine the weights of indicators at all levels to provide a basis for the training, evaluation and assessment for VTE liaison nurses. The ultimate goal is to improve the quality of VTE nursing and management and ensure patient safety.

## 2. Methods

### 2.1. Research Group

The research group was comprised of a professor of nursing, two associate professors of nursing and two charge nurses, among which three of them were clinical nursing administrators, one was the director of the VTE management team and one was the nursing manager of nursing education. They were mainly responsible for literature review, preliminary construction of the training curriculum system, expert panel selection, distribution and collection of questionnaires, collation and analysis of the results and discussions of experts' opinions.

### 2.2. Preliminary Construction of the Training Curriculum System for VTE Liaison Nurses

Liaison nurses can undertake some of the tasks of specialized nurses and work as an extension and supplementary role for them [9]. The concept of specialized nurses in China was first proposed in Hong Kong in the 1990s. Guangdong Province, taking advantage of its geographical location, has maintained long-term and good cooperation with Hong Kong in terms of specialized nurse training, and the relevant training models have been proven to be scientific and reasonable in practice [12, 13]. Therefore, this study referred to the five major categories of "Core Competencies of Specialized

Nurses" issued by the Nursing Council of Hong Kong, China to determine the first-level indicators of the training system which focused on team management and construction, management system revision, education and training construction, and quality control management for VTE liaison nurses. The framework included VTE liaison nurse nursing capabilities, health promotion and health education capabilities, management and leadership skills, practice-based research capabilities, and personal and professional development skills.

Meanwhile, relevant literature, guidelines, and practice standards were obtained from databases, e.g. National Knowledge Infrastructure, VIP Database, Wanfang Database, PubMed, Web of Science, Cochrane, and Medline. The second-level indicators were determined based on the first-level indicator framework about training objectives, content and models, etc. A preliminary structure of the VTE liaison nurse training curriculum system with 5 first-level indicators and 26 second-level indicators was built.

### 2.3. Delphi Technique Process

#### 2.3.1. Design of Questionnaire

The questionnaire consisted of five parts: a. definition of research-related concepts; b. feedback form on the first-level indicators; c. feedback form on the second-level indicators; d. general information of the experts; e. evaluation criteria of the importance rating on indicators. The experts were asked to specify the importance of indicators by using the 5-point Likert scale, rating from 5 to 1 points (from "very important" to "unimportant"). Respondents could also choose to add or delete certain indicators and give suggestions on revision.

#### 2.3.2. Selection of Experts

According to the research field, objectives, and the expert selection criteria of Delphi method [14], the inclusion criteria for experts in this study were: a. work more than ten years in VTE prevention and treatment-related fields (clinical medicine, clinical nursing, nursing management, and nursing education, etc.); b. associate professor or above professional titles, or a maximum of three VTE prevention and treatment nursing experts with the title of doctor-in-charge; c. bachelor's degree or above; d. willingness to participate in the survey. Questionnaires were issued to 30 experts who met the selection criteria.

#### 2.3.3. Delphi Surveys

Two rounds of Delphi surveys were conducted in this study, using email and WeChat to distribute and collect questionnaires. Each round lasted 3 to 4 weeks, and the results would be analyzed carefully. Indicators with mean importance rating  $\leq 3.75$  or coefficient of variation  $\geq 0.25$  or full score ratio  $\leq 0.2$  would be revised or deleted based on experts' suggestions and discussions within the research group. The results of the first round survey would be attached to the round two ques-

tionnaire as references for experts. The survey would be ended when reaching enough consensus among the experts.

## 2.4. Statistical Methods

Data were processed and analyzed by SPSS22.0 and Microsoft Excel 2019. The experts' general information was demonstrated with descriptive approaches, e.g. frequency and percentage. The reliability and credibility of the Delphi results were evaluated by the degree of expert panel's cooperation, expert authority and the consistency of expert opinions. The weights of the first-level indicators and second-level indicators were assigned base on the Analytic Hierarchy Process (AHP) and equal weighting method.  $P < 0.05$  was considered statistically significant.

## 3. Results

### 3.1. General Information of the Experts

The expert panel was comprised of 27 experienced experts in the field of VTE management and nursing from Hubei, Sichuan, Guangdong, Guangxi, and Guizhou Province in China, including 21 experts from 3A hospitals, 2 from 2A hospitals, 2 from tertiary general hospitals and 2 from colleges and universities. The age of the participants ranged from 38~59 ( $46.63 \pm 5.343$ ), and the years of working ranged from 12~42 ( $25.48 \pm 7.439$ ). 27 and 26 valid questionnaires were collected respectively from the first and second rounds of the surveys. See Table 1 for the general information of the experts.

**Table 1.** General Information of the Experts.

Category	Classification	Round 1 (n=27)		Round 2 (n=26)	
		n	Percentage (%)	n	Percentage (%)
Province	Guangdong	19	70.4	18	69.2
	Guizhou	4	14.8	4	15.4
	Sichuan	2	7.4	2	7.7
	Hubei	1	3.7	1	3.8
	Guangxi	1	3.7	1	3.8
Age	$\leq 40$	2	7.4	2	7.7
	41~	19	70.4	18	69.2
	51~60	6	22.2	6	23.1
Years of Working	$\leq 15$	2	7.4	2	7.7
	16~25	11	40.7	11	42.3
	$\geq 26$	14	51.9	13	50.0
Level of Education	Ph.D	1	3.7	1	3.8
	Master	9	33.3	8	30.8
	Bachelor	17	63.0	17	65.4
	Professor	7	25.9	7	26.9
Title	Associate Professor	17	63	16	61.5
	Doctor-in-charge	3	11.1	3	11.5
	Director of Nursing/ Director of Education and Research/ Head of Training	7	25.9	7	26.9
Position	Associate Director of Nursing/ Associate Department Director	3	11.1	2	7.7
	Charge Nurse	2	7.4	2	7.7
	Nurse Manager	15	55.6	15	57.7
Research Direction / Job De-	Nursing Management	22	81.5	21	80.8
	Nursing Education	15	55.6	15	57.7

Category	Classification	Round 1 (n=27)		Round 2 (n=26)	
		n	Percentage (%)	n	Percentage (%)
scription (Multiple choice)	Clinical Nursing (VTE-related)	21	77.8	21	80.8
	Clinical Medicine (VTE-related)	1	3.7	1	3.8

### 3.2. Experts' Degree of Cooperation

The degree of cooperation was measured by the effective response rate of the questionnaires and the rate of giving opinions. 27 out of 30 questionnaires were valid and collected in the first round, with an effective response rate of 90.0%. Eight experts (29.6%) gave their opinions. 26 out of 27 questionnaires were valid and collected in the second round, with an effective response rate of 96.3%. One expert (3.8%) gave opinions. The results indicated a high level of cooperation.

### 3.3. Expert Authority

The experts' authoritative coefficients (Cr) were measured by the judgment basis of the indicators (Ca) and the familiarity of the indicators (Cs). In the first round, the judgment basis of the indicators (Ca) was 0.930, the familiarity of the indicators (Cs) was 0.837 and the authoritative coefficients (Cr) was 0.884. In the second round, the judgment basis of the indicators (Ca) was 0.935, the familiarity of the indicators (Cs) was 0.877 and the authoritative coefficients (Cr) was 0.906. The results indicated that the participants were authoritative and credible experts.

### 3.4. Coordination of Experts' Opinions

The coordination of experts' opinions was measured by the coefficient of variation (CV) of the importance rating on each indicator and Kendall's coefficient of concordance. The coefficients of variation of the first-level indicators ranged from 0.075~0.173 and the second-level indicators from 0.000~0.321 in the first round. The coefficients of variation of the indicators ranged from 0.040~0.272 in the second round. Kendall's coefficients of concordance were 0.261 and 0.276 respectively in the two-round survey. The significance test on the indicators suggested that the results were considered statistically significant ( $P < 0.01$ ) and demonstrated a high level of consistency and reliability of experts' opinions.

### 3.5. Adjustment and Revision of Indicators

#### 3.5.1. Results of the Round One Survey

Adopted indicators should meet three criteria: mean importance rating  $\geq 4$ , coefficient of variation  $< 0.25$ , and full

score ratio  $> 0.20$ , and those did not fully meet the criteria would be deleted. During the process, for suggestions put forward by only one expert, the research group would consider revising or adding them to the next round of survey after careful discussion; for the same suggestions put forward by two or more experts, the research group would make revisions.

Based on the results and suggestions of the first round survey, the research group made the following adjustments after discussion: among the first-level indicators which all met the screening criteria, one expert suggested changing "professional, legal and ethical nursing competencies" into "direct care ability". However, given the clear definition and specific requirements for professionalism, legality and ethics in the "Core Competencies of Specialized Nurses", the suggestion was not adopted after discussion. Experts' opinions towards the first-level indicators reached consensus, which provided a framework for the training system. In terms of secondary indicators, three items that did not meet the screening criteria were deleted: item 4 (coefficient of variation: 0.273), item 17 (coefficient of variation: 0.295), and item 25 (mean importance rating: 3.67, coefficient of variation: 0.321). Four new items were added: VTE knowledge sharing, quality evaluation of VTE prevention and treatment, ability to prevent and treat VTE with multidisciplinary collaboration, and career adaptability. Five items were revised. For example, "construction of VTE prevention and management system" was changed to "construction of VTE prevention and treatment management system and application of intelligent platform"; "basic knowledge of VTE research in a healthcare setting" was changed to "capabilities to conduct VTE research in a healthcare setting: carry out research questions and literature search, consider ethical issues, design research, collect and analyze data, and publish research results"; "VTE evaluation and application of research results" was changed to "VTE evaluation and application of research results: components of research evaluation, combination of research and practice, application strategies of research outcome, evidence-based nursing practices".

#### 3.5.2. Results of the Round Two Survey

Three items in the secondary indicators did not meet the screening criteria and two of them were deleted. However, item 3 "VTE epidemiology" (coefficient of variation: 0.272) was retained after discussion because it was mentioned in

many guidelines [8, 15] and it was also helpful for liaison nurses to realize the importance of VTE prevention and treatment. A consensus was achieved and built a VTE liaison nurse training curriculum system with 5 first-level indicators and 26 second-level indicators. See Table 2 for details.

### 3.6. Weighting of Indicators

The weights of first-level indicators were calculated using

the AHP (CR=0), indicating acceptable consistency of the comparison matrices. The secondary indicators were equally weighted with the combined weight method to eliminate the influence caused by the weight distribution of the first-level indicators and the different number of secondary indicators. Two weight calculation methods were applied comprehensively in this study to improve the scientificity and reliability of the results. See Table 2 for details.

**Table 2.** Training Curriculum System for VTE Liaison Nurses.

Indicators	Mean Importance Rating (Mj)	Full score ratio (Kj)	Coefficient of Variation (Vj)	Weight	Combined Weight
1 Professional, Legal and Ethical Nursing Competencies	4.74±0.53	0.78	0.111	0.209	0.209
1.1 Relevant regulations and ethics of VTE	4.15±1.01	0.50	0.243	0.102	0.192
1.2 History and latest study of VTE	4.04±0.72	0.27	0.178	0.099	0.186
1.3 VTE epidemiology	3.96±1.08	0.35	0.272	0.097	0.183
1.4 VTE pathogenesis and risk factors	4.81±0.40	0.81	0.084	0.118	0.222
1.5 VTE diagnosis, treatment and complication management	4.77±0.43	0.77	0.090	0.117	0.220
1.6 VTE medications	4.69±0.47	0.69	0.100	0.115	0.216
1.7 VTE risk assessment	4.88±0.33	0.88	0.067	0.120	0.225
1.8 VTE prevention	4.96±0.20	0.96	0.040	0.122	0.229
1.9 VTE case analysis	4.50±0.71	0.62	0.157	0.110	0.208
2 Health Promotion and Health Education Capabilities	4.85±0.36	0.85	0.075	0.214	0.214
2.1 Educational theory and methodology	3.92±0.89	0.27	0.227	0.154	0.197
2.2 Health concept, health education and health promotion methods	4.04±0.82	0.31	0.204	0.158	0.203
2.3 Communication skills	4.19±0.85	0.46	0.203	0.164	0.211
2.4 Interview and coaching techniques	4.23±0.82	0.46	0.193	0.166	0.213
2.5 VTE health education	4.65±0.49	0.65	0.104	0.182	0.234
2.6 VTE knowledge sharing	4.50±0.71	0.62	0.157	0.176	0.226
3 Management and Leadership Skills	4.15±0.72	0.33	0.173	0.183	0.183
3.1 Management theory, techniques and applications	3.88±0.86	0.27	0.223	0.185	0.169
3.2 VTE-related healthcare policy	3.96±0.92	0.38	0.231	0.188	0.172
3.3 Construction of VTE prevention and treatment management system and application of intelligent platform	4.31±0.68	0.42	0.158	0.205	0.187
3.4 Construction of “embolism-free” unit	4.23±0.77	0.42	0.181	0.201	0.184
3.5 Quality evaluation of VTE prevention and treatment	4.65±0.63	0.73	0.135	0.221	0.202
4 Practice-based Research Capabilities	4.48±0.70	0.59	0.156	0.198	0.198
4.1 Capabilities to conduct VTE research in a healthcare setting: carry out research questions and literature search, consider ethical issues, design research, collect and analyze data, and publish research results	4.31±0.74	0.46	0.171	0.241	0.191
4.2 VTE evaluation and application of research results: com-	4.38±0.70	0.50	0.159	0.245	0.194



Indicators	Mean Importance Rating (Mj)	Full score ratio (Kj)	Coefficient of Variation (Vj)	Weight	Combined Weight
ponents of research evaluation, combination of research and practice, application strategies of research outcome, evidence-based nursing practices					
4.3 Interpretation of VTE-related Guide	4.69±0.55	0.73	0.117	0.262	0.208
4.4 Latest Research on VTE	4.50±0.58	0.54	0.130	0.252	0.199
5 Personal and Professional Development Skills	4.44±0.75	0.56	0.169	0.196	0.196
5.1 Establish and Maintain VTE Nursing Profession	4.15±0.83	0.38	0.201	0.484	0.190
5.2 Ability to prevent and treat VTE with multidisciplinary collaboration	4.42±0.70	0.54	0.159	0.516	0.202

## 4. Discussion

### 4.1. Scientificity and Reliability of the Constructed Curriculum Training System

The scientificity and reliability of the research results mainly depend on the professionalism and the number of experts in the Delphi survey [16]. This study follows the principles of representativeness and authority and invites 27 experts, which meets a panel size of 15 to 50 participants [14], from five provinces across the country as respondents. All experts are theoretically and practically experienced in the field of VTE prevention and treatment, nursing management and nursing education.

The response rates of the two rounds of questionnaires in this study are 90.0% and 96.3% respectively. Eight experts (29.6%) give their opinions in round one and one expert (3.8%) offer advice in round two, suggesting a high degree of cooperation. Besides, it is generally believed that experts' authoritative coefficient should be above 0.7 [17], since the more credible the expert, the more reliable the results. The expert authoritative coefficients in this study are 0.884 and 0.906 respectively, indicating high-level credibility and reliability. Some literature [18] suggests that the experts' opinions are relatively consistent if the coefficient of variation is less than 30%, and the results of the two-round survey both conformed to this standard, indicating a high level of consistency. It is also measured by Kendall's coefficients of concordance (ranging from 0 to 1), and the larger the value, the better the coordination [14]. Meanwhile, a significance test is conducted to evaluate the degree of consensus among experts (the smaller the P value, the greater the degree of consensus). The Kendall's coefficients of concordance of this study were 0.261 and 0.276 respectively with  $P < 0.01$ , indicating that experts' opinions became more consistent as the Delphi round proceeded.

In addition, this study employs the AHP and equal

weighting method to determine the weights of the first-level and second-level indicators respectively, which to a certain extent reduces the impact of subjectivity in Delphi method and improves the accuracy and reliability of the research results [19]. According to some literature [20], the lower the consistency ratio ( $CR < 0.1$ ) in the AHP, the higher the consistency of the judgment matrix. The weights of the first-level indicators pass the consistency test, suggesting that the weight distribution is scientific and reliable.

### 4.2. Analysis of the Evaluation Indicators

There are 5 first-level indicators and 26 second-level indicators in the constructed VTE liaison nurse training curriculum system. The mean importance ratings and weights of indicators at all levels can provide references for clinical practice, highlight the structure and key points of the training curriculum system, and more importantly, truly reflect clinical needs.

The weights of first-level indicators are as follows (in descending order): health promotion and health education capabilities (0.214), professional, legal and ethical nursing competencies (0.209), practice-based research capabilities (0.198), personal and professional development skills (0.196), management and leadership skills (0.183). The expert panel believes that the ability of health promotion and health education is of great significance for VTE liaison nurses since VTE is a preventable disease in hospitals despite its high mortality and high morbidity in some groups [21]. The incidence of VTE can be reduced by delivering systematic and standards-based health education to improve patients' understanding and initiative in preventing VTE [22]. Also, nurses' knowledge and skills in VTE epidemiology, pathogenesis, risk assessment, complication management, and prevention are crucial for evaluating their professional, legal and ethical nursing capabilities. Research [23, 24] suggests that nurses' professional competencies can directly affect the clinical observation and care of VTE patients and ultimately affect patients' prognosis. Therefore, it is essential to improve

nurses' knowledge and awareness of VTE to ensure effective VTE management through systematic training [25].

Among the secondary indicators, the top three indicators with the highest weights are VTE health education (0.234), VTE prevention (0.229) and VTE knowledge sharing (0.226) under the "Health promotion and health education capabilities" and "Professional, legal and ethical nursing capabilities", which are consistent with the weight distribution of the first-level indicators, and once again confirm experts agreement on emphasizing VTE prevention education and practical training. The results show that VTE liaison nurse training and assessment should focus on the capabilities of delivering health education and nursing practice abilities. It is believed that constructing a comprehensive, systematic and standardized liaison nurse training system can make great contributions to effective VTE management and patient safety.

### 4.3. Implications

At present, the liaison nurse training systems in the fields of diabetes, hospital-acquired infections, wound and ostomy, etc. are relatively mature in China. However, there are lack of common evaluation standards for VTE liaison nurse training and assessment and the existing training systems vary considerably in different areas. Professionally trained VTE liaison nurses can not only serve as an important communicator across departments in the hospital but also have positive impacts on VTE prevention and management in medical institutions. Therefore, it is urgent and vital to build a comprehensive and systematic training system for VTE liaison nurses.

In 2021, the Nursing Professional Committee of the International Union of Angiology China Branch published the "Expert Consensus on Preventive Nursing and Management of Venous Thromboembolism in Inpatients" [26], proposing that training can enhance nurses' capabilities of VTE risk assessment, preventive care, nursing documentation and patient care to improve VTE prevention and reduce the incidence of VTE. With reference to the above guidance and the "Five Core Competencies of Specialized Nurses", this study constructs a training framework for VTE liaison nurses and points out existing problems and potential improvement for systematic and standardized VTE management based on the importance ratings of indicators at all levels, so as to provide references for VTE liaison nurse training in medical institutions.

## 5. Conclusions

This study constructs a VTE liaison nurse training curriculum system through literature review, research on guidelines, expert consensus and practice standards, and processing the data with Delphi surveys and weight analysis. It is believed to be highly scientific and reliable and can provide guidance for the content framework for training, assessment and certifica-

tion of clinical VTE liaison nurses.

There are still certain limitations in this study. For example, the results could be subject to the subjective nature of Delphi method, and the details of this training system remain to be discussed in consideration of different situations and needs in various medical institutions. In the next stage, official training based on the constructed training curriculum system will be launched, and the research group will evaluate the effect of the system to further improve and specify the training content.

## Abbreviations

VTE: Venous Thromboembolism

AHP: Analytic Hierarchy Process

DVT: Vein Thrombosis

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## Authors' Contributions

Ge Guo and Li Lan contributed equally to this study.

## Conflicts of Interest

The authors declare no conflicts of interest.

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