

ORIGINAL RESEARCH

# A Survey on the Current Status of Adult External Ventricular Drainage Care: Exploring Content Framework and the Need for Group Standards

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## ABSTRACT

**Background** • External ventricular drainage (EVD), a widely used clinical procedure, faces slow translation of knowledge into practice due to practical barriers. The scarcity of high-quality data in the past EVD management and neurocritical care research compounds the challenge.

**Objective** • This study aims to investigate the current status of adult external ventricular drainage care among neurosurgical nurses, delineate nursing priorities and challenges, and explore the necessity for establishing standardized guidelines for external ventricular drainage care.

**Methods** • We conducted a systematic literature search to identify existing clinical guidelines, systematic reviews, evidence summaries, and expert consensus on adult external ventricular drainage care. We developed an electronic questionnaire titled “Survey on the Current Status of Adult External Ventricular Drainage Care” based on our search results. We distributed it to certified registered neurosurgical nurses working in the top 20 neurosurgery hospitals, per the 2022 Fudan Hospital

Ranking published by the Institute of Hospital Management at Fudan University.

**Results** • Effective control of drainage speed and total volume is a crucial aspect of nursing care. Existing guidelines primarily emphasize infection prevention in the context of complication care. However, it was observed that nursing staff exhibited limited knowledge concerning the total volume (58.7%) and rate of cerebrospinal fluid drainage (50.8%), as well as the management of complications (56.7%). Factors influencing the extent of nursing knowledge related to external ventricular drainage care include levels of education ( $P = .022$ ), professional titles ( $P = .004$ ), department assignments ( $P < .001$ ), and the completion of relevant training ( $P = .01$ ).

**Conclusions** • Establishing standardized guidelines for external ventricular drainage care is imperative to bridge the gap between existing evidence and clinical practice. (*Altern Ther Health Med.* 2024;30(5):244-248)

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## INTRODUCTION

External ventricular drainage (EVD) plays a vital role in the clinical management of severe traumatic brain injuries complicated by hydrocephalus and intracranial hemorrhage to alleviate intracranial pressure, enhance brain tissue oxygenation, and mitigate or prevent brain herniation.<sup>1</sup> This procedure aims to alleviate intracranial pressure, enhance brain tissue oxygenation, and prevent potentially catastrophic complications like brain herniation. EVD is more than a therapeutic intervention; it also serves as an essential tool for

continuous intracranial pressure monitoring.<sup>2</sup> The primary objective of EVD is to consistently remove cerebrospinal fluid from the ventricles into an external, closed system.<sup>3</sup>

The established efficacy of EVD has attained recognition and endorsement from esteemed organizations such as the Brain Trauma Foundation, the American Heart Association, the Joint Committee of the American Neurosurgical Association, and the Congress of Neurosurgery.<sup>4-6</sup> It also holds a significant place in guidelines for the comprehensive management of craniocerebral trauma.<sup>6</sup>

In the acute management of hydrocephalus and intracranial hypertension in critically ill neurological patients, the placement of EVD is frequently an urgent and life-saving intervention. EVD is a commonly employed technique in neurosurgery clinics and has received significant attention. Once the EVD is in place, critical objectives include optimizing brain tissue physiology, minimizing complications, and determining the appropriate timing for EVD removal.<sup>7</sup>

EVD procedure is performed over 40 000 times annually in the United States alone.<sup>8</sup> The care of EVD represents a specialized and high-risk aspect of neurosurgery. It involves the maintenance of drains and requires vigilant management of associated complications, a critical responsibility for nursing staff. Providing precise and diligent care is a crucial predictor of favorable outcomes.<sup>9,10</sup> While many evidence-based resources have been developed in relevant fields, translating research findings into practice is often a slow and intricate process.<sup>11</sup>

Despite having the most robust available evidence, a substantial research gap exists in EVD clinical practice.<sup>12</sup> This study aimed to explain the foundational framework and essential components for a standardized care protocol for adult EVD based on evidence-driven principles. It seeks to bridge this gap by synthesizing the best available evidence with clinical nursing practice recommendations and expert opinions to facilitate optimal care and enhance the overall quality of care.

## MATERIALS AND METHODS

### Study Design

A multicenter cross-sectional study was conducted involving registered nurses in neurosurgery from 15 of the top 20 hospitals listed in the 2022 Fudan edition of the China Hospital Rankings published by the Institute of Hospital Management, Fudan University. The study included registered nurses with a minimum of 12 months of experience in neurosurgery.

### Inclusion and Exclusion Criteria

Inclusion criteria were as follows: (1) Registered nurses with a minimum of 12 months of experience in neurosurgery; (2) Nurses employed in neurosurgery departments at the 15 predetermined hospitals; (3) Nurses who provided written informed consent and voluntarily participated in the research. Exclusion criteria were as follows: (1) Nurses currently in training or serving as practice nurses; (2) Nurses who were not present during the survey; (3) Nurses who declined to participate in the research.

### Literature Search and Selection

An extensive literature search on EVD utilizing various sources, including the China Medical Guide website and professional society/association websites, was conducted. The databases include Web of Science, PubMed, Embase, Cochrane, China Wanfang, and Zhiwang databases. The search was restricted to journal papers published within the last decade, resulting in a total of 8096 references. After removing duplicates and organizing the results in Endnote, 7066 unique references were obtained.

### Review of the Literature

Five members of the literature search team carefully reviewed the titles and abstracts of the identified papers. Inclusion criteria were established as follows: (1) The study focused on adult patients receiving EVD; (2) The study incorporated nursing management; and (3) The study assessed

the impact of nursing management. Articles such as reviews, comments, and basic research were excluded from consideration. Ultimately, 666 articles that met these criteria were selected.

### Selection of Relevant Content

To further refine the literature, we evaluated the relevance of the content by reading the full text of the selected articles and excluded those that did not align with our research objectives. After this evaluation, 72 articles were identified and used as the theoretical foundation for the development of the questionnaire “*Survey on the Current Status of EVD Care in Adults*.”

### Questionnaire Design

The questionnaire was structured into two main parts. The first part encompassed general information, which included details such as gender, age, education level, years of work, job title, position, hospital location by province, department of employment (whether in neurological or critical care nursing), and whether the respondents had received specific training in EVD care.

The second part of the questionnaire was dedicated to assessing adult EVD care. Within this section, the questionnaire was further divided into three key areas: Knowledge, Beliefs, and Behaviors. In the Knowledge section, participants answered 15 items, where each correct answer earned them 1 point, resulting in a total score out of 15. The Belief section featured 10 items, offering respondents response options of “strongly agree, agree, unsure, disagree, strongly disagree.” The Behavior section contained 10 items. The Beliefs and Behaviors sections serve the purpose of gaining insight into the perceptions of nursing staff and their actual practices in clinical care.

### Participant Selection and Ethics Approval

In the participant selection process, a random cluster sampling method was employed. Fifteen hospitals were randomly chosen from the top 20 hospitals specializing in neurosurgery according to the 2022 Fudan edition of the China Hospital Rankings. Subsequently, all registered nurses working in these selected hospitals were cluster-sampled during the study period, resulting in a cohort of 841 participants. An electronic questionnaire was distributed to all participants. This study received an exemption from requiring approval by our institution’s ethics committee.

### Evaluation Criteria

The evaluation criteria were based on the correct answer rate for each item in the questionnaire “*Survey on the Current Status of EVD Care in Adults*.” This specific indicator was employed to determine the extent of nurses’ awareness regarding EVD management knowledge.

### Statistical Analysis

Statistical data analysis was conducted using SPSS 23.0 (IBM, Armonk, NY, USA). Frequency and composition ratios were utilized for count data, while descriptive statistics

**Table 1. Demographic Information of Survey Respondents**

Projects	Grouping	Number of People (Cases)	Composition Ratio (%)
Gender	Male	65	7.73
	Female	776	92.27
Age	21 to 30 years old	222	26.40
	31 to 40 years old	487	57.91
	41 to 50 years old	112	13.32
	51 to 60 years old	20	2.38
Education Level	Technical Secondary School	12	1.43
	College	99	11.77
	Bachelor	706	83.95
	Master and above	24	2.85
Years of Work	Less than 3 years	56	6.66
	3 to 5 years	86	10.23
	6 to 10 years	255	30.32
	11 to 20 years	330	39.24
	21 to 30 years	86	10.23
	Over 30 years	28	3.33
Title	Nurse	118	14.03
	Nurse Practitioner	338	40.19
	Nurse Supervisor	323	38.41
	Deputy Chief Nursing Officer	54	6.42
	Chief Nursing Officer	8	0.95
Position	Nurse	758	90.13
	Full/Deputy Nurse Manager	66	7.85
	Head Nurse	15	1.78
	Director / Deputy Director of Nursing	2	0.24
Section	Neurosurgical Care Unit	292	34.72
	Neurosurgery Ward	549	65.28
Whether the nurse is a specialist	Yes	202	24.02
	No	639	75.98
Whether or not they have received EVD training related to standardized care	Yes	648	77.05
	No	193	22.95

Note: This table provides an overview of the demographic characteristics and professional attributes of the survey respondents. The data is categorized by gender, age, education level, years of work, job title, position, work section, specialization, and the receipt of EVD training related to standardized care. The composition ratios represent the distribution of respondents within each category as a percentage of the total number of valid survey responses (841 cases).

**Abbreviations:** EVD, External Ventricular Drainage.

such as means and standard deviations were employed for normally distributed measurement data. To compare different influencing factors, *t* tests or analysis of variance (ANOVA) were applied. Additionally, 95% confidence intervals (CI) were used for estimation.

**RESULTS**

**Demographic Information of Nursing Staff**

Out of the 925 collected questionnaires, 84 were found to be invalid, leaving a total of 841 valid responses for analysis. The general characteristics of the respondents are summarized in Table 1. A majority of the respondents were female (92.27%), aged between 31 and 40 years (57.91%), held a Bachelor’s degree (83.95%), had 11 to 20 years of work experience (39.24%), held the title of Nurse Practitioner (40.19%), worked as Nurses (90.13%), and were assigned to the neurosurgery ward (65.28%).

**Correct Response Rate for Each Knowledge Item**

Table 2 illustrates the correct response rates for each knowledge item. Nursing staff displayed deficiencies in their knowledge regarding the total amount (58.7%) and rate of cerebrospinal fluid drainage (50.8%) and in their ability to manage complications (56.7%).

**Table 2. Percentage of Correct Answers for Each Knowledge Entry**

No	Entry	Correct Rate (%)
	The average rate of cerebrospinal fluid drainage should be less than ( ) ml/h, and exceeding this rate may lead to intracranial hemorrhage	50.8
	Which of the following symptoms or complications may result from excessive drainage of cerebrospinal fluid ( )	56.7
	The amount of cerebrospinal fluid produced by a normal adult is ( ) ml per day	58.7
	When cerebrospinal fluid drainage is suddenly reduced during EVD and patency cannot be restored by briefly lowering the height of the drainage tube, which of the following conditions is considered likely ( )	59.0
	The following is not a function of EVD ( )	62.2
	When cerebrospinal fluid reflux is detected, the correct treatment is ( )	69.2
	The following are not signs of infection and risk factors associated with EVD tubes ( )	76.0
	Which of the following symptoms or complications may result from inadequate drainage of cerebrospinal fluid ( )	80.7
	Normally, the highest point of the EVD tube is located in the plane of the lateral ventricle ( )	82.0
	The lateral ventricular plane is located in the ( )	82.9
	Normal adult intracranial pressure is ( ) mmHg or ( ) mmH <sub>2</sub> O	83.0
	When which of the following conditions can not be closed pipe test ( )	87.2
	Which of the following care measures is not appropriate after removal of the EVD tube ( )	92.5
	When the patient’s EVD tube is completely dislodged, the correct treatment is ( )	97.1
	The appearance of normal cerebrospinal fluid is characterized by ( )	97.5

Note: This table presents the percentage of correct answers for various knowledge entries related to External Ventricular Drainage (EVD) care. Respondents were evaluated based on their knowledge of EVD management, and the table showcases the correct response rates for each knowledge entry. The correct rates are expressed as percentages, highlighting the proficiency of the nursing staff in understanding critical aspects of EVD care. A higher percentage indicates a greater level of correct responses.

**Table 3. Univariate Analysis of the Degree of Knowledge of EVD Among Nursing Staff with Different Characteristics (n = 841)**

Projects	Composition Ratio (%)	Score	Statistical values	P value
Gender			0.476	.634
Male	65 (7.7)	11.5±2.77		
Female	776 (92.3)	11.3±2.38		
Education Level (Final Degree)			9.638	.022
Technical Secondary School	12 (1.4)	10.0±1.71		
College	99 (11.8)	10.7±3.26		
Bachelor	706 (83.9)	11.5±2.26		
Master And Above	24 (2.9)	11.3±2.39		
Years of Work			8.641	.124
Less than 3 years	56 (6.7)	10.7±3.36		
3 to 5 years	86 (10.2)	11.3±2.39		
6 to 10 years	255 (30.3)	11.1±2.46		
11 to 20 years	330 (39.2)	11.5±2.19		
21 to 30 years	86 (10.2)	11.9±2.20		
Over 30 years	28 (3.3)	11.7±2.49		
Title			15.293	.004
Nurse	118 (14.0)	10.7±2.94		
Nurse Practitioner	338 (40.2)	11.2±2.43		
Nurse Supervisor	323 (38.4)	11.6±2.08		
Associate Chief Nursing Officer	54 (6.4)	11.9±2.61		
Chief Nursing Officer	8 (1.0)	12.8±2.19		
Section			-4.039	<.001
Neurosurgical Care Unit	292 (34.7)	11.8±2.11		
Neurosurgery Ward	549 (65.3)	11.1±2.53		
Whether the nurse is a specialist			1.278	.201
Yes	202 (24.0)	11.5±2.46		
No	639 (76.0)	11.3±2.40		
Have received training on standardized care for EVD			2.580	.010
Yes	648 (77.1)	11.5±2.42		
No	193 (22.9)	11.0±2.34		

Note: This table provides an overview of the univariate analysis conducted to assess the degree of knowledge of External Ventricular Drainage (EVD) among nursing staff with varying characteristics. The analysis examines the composition ratio of respondents within different groups, their average scores, and the statistical values associated with these characteristics. The *P*-values in the table reflect the statistical significance of the associations between the specified characteristics and the degree of knowledge related to EVD among the nursing staff. A lower *P*-value suggests a stronger statistical association, while a higher *P*-value indicates a weaker association.

## Univariate Analysis of EVD Knowledge Among Nursing Staff with Diverse Characteristics

It is evident from the findings that various factors significantly influence the degree of knowledge regarding EVD among nursing staff. These factors include levels of education ( $P = .022$ ), professional titles ( $P = .004$ ), departments of employment ( $P < .001$ ), and whether they have received specific training ( $P = .01$ ).

## DISCUSSION

### Existing International and National Standards for EVD Care

Several important international and national standards have been established for the care of EVD. In 2016, the American Association of Neuroscience Nurses introduced the “*Establishment of an External Ventricular Drain Best Practice Guideline: The Quest for a Comprehensive, Universal Standard for External Ventricular Drain Care*”.<sup>13</sup> This guideline produced formal infection control policies and procedures for EVD, setting rigorous standards for placement and operation within healthcare settings.

Similarly, in 2016, the American Association for Neurocritical Care issued “*The Insertion and Management of External Ventricular Drains: An Evidence-Based Consensus Statement*”.<sup>4</sup> This statement was focused on summarizing the evidence for reducing ventriculostomy-related infections (VRI). Furthermore, the 2017 edition of the American Society for Anesthesiology and Critical Care Society of Neuroscience Guidelines, titled “*Perioperative Management of Adult Patients with External Ventricular and Lumbar Drains*”,<sup>8</sup> primarily focuses on the medical direction and offers guidance to physicians for the standardized management of EVD in perioperative settings. It comprehensively outlines the indications, contraindications, complications, and considerations related to EVD, encompassing preoperative evaluation, intraoperative management, patient transport, and EVD management in special clinical scenarios, and includes a perioperative checklist for EVD.

The 2018 edition of the “*Chinese Expert Consensus on External Cerebrospinal Fluid Drainage in Neurosurgery*”<sup>11</sup> outlines the essential aspects of EVD, including indications, contraindications, intraoperative protocols, postoperative monitoring, and nursing guidelines. Similarly, the 2019 edition of the “*Chinese Expert Consensus on Cerebrospinal Fluid Management in Patients with Craniocerebral Trauma*”<sup>14</sup> presents insights into dynamic changes in cerebrospinal fluid following craniocerebral trauma, the associated pathophysiology, and medical interventions for cerebrospinal fluid management. This consensus emphasizes the significance of attention to drainage tube height setting, drainage flow control, intracranial pressure monitoring, and aseptic procedures in treatment.

### Limited Knowledge Among Nursing Staff Regarding EVD

The relatively low rate of correct answers provided by nursing staff in response to questions related to the total cerebrospinal fluid amount, drainage rate, and the assessment

and management of complications underscores the practical challenges in effectively controlling the drainage rate and total volume in clinical care. Notably, VRI emerges as the most prevalent complication associated with EVD. Hence, most hospital policies primarily focus on reducing infection rates, and nursing staff demonstrate a higher proficiency in infection prevention as a quality-of-care metric compared to their ability to prevent, assess, and manage other associated complications.

Notably, the level of knowledge among nursing staff in the neurosurgical care unit surpasses those working in the general wards, likely due to the awareness of EVD patient management within the care unit. Thamjamrassri et al.<sup>6</sup> conducted a survey involving 30 hospitals, revealing that 80% of these hospitals exclusively managed patients with EVD in the ICU. The survey also highlighted that nurses who underwent training in standardized EVD care demonstrated significantly higher knowledge levels than their non-trained counterparts. This finding suggests that training can be an effective tool in enhancing nurses' knowledge. However, it is important to note that only 77% of the neurosurgical nursing staff in the survey received such training.

Sakamoto et al.<sup>15</sup> observed that nurses bear a significant responsibility for the care of patients with EVD, encompassing the management of catheters and overall systemic care. Given this role, nursing staff should be well-prepared to assess, prevent, control, and identify potential risks associated with the EVD system, ultimately preventing potential complications. The department must implement systematic and standardized nurse training programs to achieve this competence. These programs should be focused on EVD knowledge and promote ongoing education for clinical nurses to enhance their proficiency in this domain.

Our study identified several important findings directly relevant to patient care in EVD. Firstly, we observed that nursing staff, particularly those in neurosurgical care units, exhibited a more comprehensive understanding of EVD management. This observation indicates the concentrated nature of EVD patient care within specialized units, emphasizing the need for tailored training and education in these clinical environments.

Furthermore, the results highlight a significant knowledge gap concerning specific aspects of EVD management. Notably, nursing staff displayed lower knowledge levels in areas related to the total amount and rate of cerebrospinal fluid drainage and the judgment and management of complications. This finding suggests a critical need for targeted training programs to address these knowledge deficits.

Our study also found that prior training in standardized EVD care significantly correlated with higher knowledge levels among nursing staff. This finding underlines the effectiveness of training programs in enhancing EVD-related knowledge. However, it is important to note that a significant proportion of nursing staff had not received such training, indicating room for improvement in educational initiatives

within healthcare institutions. These findings emphasize the importance of systematic and standardized training on EVD for nursing staff. Ensuring that nursing professionals are well-equipped to assess, prevent, control, and identify potential risks and complications in the EVD system is crucial for patient safety and quality of care.

### Study Limitations

It is important to acknowledge the study's limitations. The use of electronic questionnaires may have introduced the possibility of nurses searching for correct answers, potentially affecting the response accuracy. Additionally, the study's sample primarily consisted of certified registered nurses from top-tier neurosurgery hospitals, limiting the generalizability of the findings to all healthcare settings.

### CONCLUSION

In conclusion, this study has illustrated critical issues in the EVD process from a nursing perspective. Developing group standards for EVD signifies an important step toward addressing clinical challenges regarding EVD condition observation, nursing assessment, drainage fixation and protection, drainage flow regulation, transport, drainage removal, complication prevention, and overall nursing care. These standards aim to provide comprehensive guidance for nursing staff across all healthcare levels and within various medical institutions. Standardization of EVD nursing care practices can help rectify patient care disparities stemming from the absence of relevant nursing guidelines and inconsistent local standards. This unification of EVD care practices will enhance patient safety and foster a more systematic and efficient approach to managing EVD cases, benefiting both patients and the healthcare community. Therefore, improving the knowledge and proficiency of nursing staff in EVD management is integral to enhancing patient safety, reducing complications, and maintaining the highest standards of care in neurosurgical units.

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### CONFLICT OF INTERESTS

The authors report no conflict of interest.

### AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of this study are available from the corresponding author upon request, subject to reasonable conditions.

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