Risk Management and Healthcare Policy

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ORIGINAL RESEARCH

ICU Nurses' Perception of Sensitive Indicators of Quality of Care for ECMO Patients in Guizhou Province, China: A Cross-Sectional Study

An-Ni Cui[1,*], Yun Wang[1,*], Ya-Ling Li[1,2], Zhang-Shuang-Zi Li[1,3], Ao-Ran Xu[1], Xin Li[1], Ya-Xian Han[1]

[1]School of Nursing, Guizhou Medical University, Guiyang, Guizhou, People's Republic of China; [2]Nursing Department, Affiliated Hospital of Guizhou Medical University, Guiyang, Guizhou, People's Republic of China; [3]Department of Critical Care Medicine, Affiliated Hospital of Guizhou Medical University, Guiyang, Guizhou, People's Republic of China

*These authors contributed equally to this work

Correspondence: Ya-Ling Li; Zhang-Shuang-Zi Li, Email liyaling0118@126.com; lzszlee@126.com

Purpose: This study aimed to investigate the cognitive evaluation level of ICU nurses in Guizhou Province, China, on the sensitivity indicators of nursing quality for ECMO patients.

Patients and Methods: This was a cross-sectional observational study conducted in Guizhou Province, China, from May to July 2023, 259 ICU nurses were surveyed. Objective sampling method was used to select the participants from 10 hospitals in Guizhou Province that carried out ECMO. Data were collected through questionnaire survey. Two researchers checked and recorded Epidata 3.1. SPSS 25.0 was used for statistical analysis of the data, and frequency, mean and component ratio were used for descriptive statistical analysis. The importance rating was used to reflect the degree of nurses' agreement with the indicators.

Results: The results of this study showed that 79.1% of the 253 ICU nurses in Guizhou Province, China, had not participated in training and courses related to indicators of quality of care evaluation for ECMO patients. The main way for ICU nurses to acquire knowledge related to indicators of quality of care sensitivity for ECMO patients was departmental training, which accounted for 87.4%. And the other ways, in descending order, were public, the matic lectures or academic conferences, journals and magazines; their evaluation scores of the importance of most of the quality of care sensitivity indicators for ECMO patients was moderate, with the scores ranging from 73 to 150. Among them, the range of importance evaluation scores for each indicator was 4.01 ~ 4.48.

Conclusion: The overall cognitive evaluation of ICU nurses in Guizhou Province, China, on most sensitivity indicators of quality of care for ECMO patients was moderate, and there is a general lack of systematic courses and training on the knowledge related to ECMO care quality sensitive indicators.

Keywords: Extracorporeal membrane oxygenation, quality of care, sensitive indicators, cross-sectional study

Introduction

Extracorporeal membrane oxygenation (ECMO) is an advanced extracorporeal life support technique that provides partial or complete respiratory and circulatory support to patients with acute respiratory conditions that can also be accompanied by circulatory failure for whom conventional life support is ineffective.[1–3] Driven in part by the 2009 H1N1 influenza pandemic and the 2019 coronavirus disease (COVID-19) pandemic, ECMO has evolved from a form of resuscitative treatment for patients with a low likelihood of survival to a routine part of high-level critical care, and it has become a life-saving support modality for patients in critical care medicine.[4–7] According to the Extracorporeal Life Support Organization (ELSO) statistic,[8,9] as of April 18, 2023, a total of 16,803 cases of ECMO were conducted in the year 2022, with a cumulative total of 196,108 cases, and 54% of the patients survived to hospital discharge or transfer. However, ECMO is technically complex, demanding, and challenging to manage during operation;[10,11] Therefore, it often requires specialized teamwork, and ECMO nurses play a significant role during the treatment or

Received: 18 December 2023
Accepted: 10 May 2024
Published: 30 May 2024

management of ECMO patients.[12] Previous studies have shown that 55% of patients experienced complications such as hemorrhage and cerebral infarction during ECMO support due to inadequate monitoring of their condition, and the cumulative incidence of 90-day in-hospital mortality was 37.4%.[13,14] However, in recent years, the development of ECMO technology has been in the initial stage, and most hospitals in China are relatively inexperienced in managing ECMO and preventing and treating its complications. Once complications occur in ECMO patients, the prognosis of the patients will be seriously affected, significantly reducing their quality of life.[15,16]

Therefore, how to ensure the quality and safety of ECMO patient care has become an urgent problem. At the same time, this also puts forward more in-depth requirements for the evaluation indexes of the quality of care for ECMO patients and the assessment standards. However, its specific implementation standards mainly depend on the behavior of clinical caregivers, and the behavioral approach is primarily influenced by the cognitive level.[17] Therefore, the degree of clinical nursing staff's awareness of the quality of care evaluation indexes for ECMO patients will directly affect the quality of care for ECMO patients and whether nurses are able to provide scientific and practical care for the patients;[18] Although there have been previous studies related to the quality of care for ECMO patients and have improved the quality of care for ECMO patients to a certain extent,[19–21] the long-term effects are unclear and it is thought that it may be related to the nurses' insufficient awareness. In contrast, fewer surveys have been reported on this issue among ICU nurses in Guizhou Province, China.

Based on this, this study intends to use a self-designed questionnaire to analyze the current cognitive status of ICU nurses in hospitals with ECMO-supported technologies in Guizhou Province, China, and to provide a reference basis for the development of related training at a later stage.

Material and Methods

Study Design

The design of this study was a cross-sectional study that was part of a larger study.

Setting and Participants

This cross-sectional study was conducted in 10 tertiary hospitals in Guizhou Province, China, where ECMO technology is practiced. Between May and June 2023, 259 ICU nurses were recruited as respondents using purposive sampling method. A self-designed questionnaire was used to conduct the survey by distributing questionnaires through Questionstar. Purposive sampling is a non-probability sampling method that draws a purposive sample from a target population to understand the problems of a specific population.[22,23]

Eligibility Criteria

Inclusion criteria: a) registered nurses directly involved in the care of ECMO patients, b) ≥ one year working experience of acute and critical care, c) college degree or above, d) voluntary participation in this study.

Exclusion criteria: rotating nurse, further training nurses, and nurses were on vacation.

Procedures

According to the investigation needs of this study, a large number of domestic and foreign related literature were reviewed, and based on the review of related literature,[21,24] the questionnaire was designed in close conjunction with the key aspects of the nursing process of ECMO patients.

After the first draft of the questionnaire was formed, 16 experts from Shanghai, Shandong, Beijing, Jiangsu, etc, who were engaged in ECMO-related clinical care, nursing management, nursing education or clinical medicine (deputy senior title or above, bachelor degree or above; Associate senior or above, bachelor's degree or above; no less than 5 years of relevant work experience) were invited to carry out 2 rounds of expert consultation, and the first draft of the questionnaire was revised and perfected to form the final questionnaire, in order to ensure the clinical practicability and scientificity of the questionnaire.

After the formation of the questionnaire, 30 ICU nurses from hospitals in Guizhou Province, China, where ECMO technology was implemented were selected for the pre-survey, and the Cronbach's alpha coefficient was 0.903, which indicated that the questionnaire had a good internal consistency. In addition, 10 experts in the field were invited to test the questionnaire's content validity, and the content validity of the questionnaire was calculated based on the results of the expert correspondence. Item-level content validity index and scale-level content validity index are usually used to assess the content validity of the questionnaire. When more than six experts assessed the questionnaire, the item-level content validity was not less than 0.78.[25,26]

In addition, ten experts in the field were invited to test the questionnaire's content validity. The item-level content validity of the questionnaire ranged from 0.800–1.000, with only two items having a content validity of 0.900, one item having a content validity of 0.800, and the rest of the items having a content validity of 1.000. The content validity index of the scale was 0.987, which indicates that the questionnaire has good content validity.

Outcome and Measures

The questionnaire on ICU nurses' perception of sensitivity indicators of ECMO patient care quality in Guizhou Province, China, contained three parts: the description of study objectives, general information sheet, the perception of sensitivity indicators of ECMO patient care quality.

The general information sheet included gender, age, highest education, title, department, years of working experience in ICU, whether is a specialized nurse in ICU, whether has participated in training related to quality-sensitive indicators of care for ECMO patients, whether has taken a course related to quality-sensitive indicators of care for ECMO patients, and ways to acquire knowledge related to quality-sensitive indicators of care for ECMO patients.

The ECMO patient care quality sensitivity indicator cognitive questionnaire includes 9 aspects and 3 dimensions, including management system and standardization, personnel management, item management, ECMO on-boarding preparation, ECMO operation management, ECMO patient care assessment and implementation, clinical complications, nursing adverse events, and evaluation of effects, with a total of 30 entries.

The degree of importance of each indicator was described according to a 5-point likert scale, ranging from "not important at all" to "very important" on a scale of 1–5, and nurses were asked to choose the corresponding score, with only one score for each entry. The grading criteria are divided into four categories: 4.70–5.00 is excellent, 4.40–4.69 is good, 4.10–4.39 is moderate, and less than 4.10 is poor.[27] The higher the score, the better the ICU nurses agreed with the sensitivity indicators of the quality of care for ECMO patients.

Data Collection

The research questionnaire of this study has gone through 2 rounds of expert correspondence stage. The questionnaire was administrated online. The researcher filled the questionnaire into the questionnaire star, and contacted the head of the departmental nurses of the hospitals under investigation before the survey, explaining the purpose, significance, inclusion and exclusion criteria, and precautions for completing the questionnaire. After obtaining informed consent from the participants, the head of each hospital department forwarded the questionnaire to the ICU nurses for completion, and emphasized that the questionnaire was filled in anonymously to ensure the authenticity of the questionnaire. Before filling out the questionnaire, each question was set as a mandatory question, the minimum answer time was set at 5 minutes, and the same IP address or the same WeChat was limited to filling out the questionnaire only once to ensure the quality of the questionnaire and the completeness of filling out the questionnaire.

Ethics Approval and Consent to Participate

The study protocol was developed in strict compliance with the ethical guidelines of the Declaration of Helsinki. And it was approved by the Ethics Committee of Guizhou Medical University (2022 Ethics No. 741), and all methods were performed in accordance with the Strobe Statement. The research subjects who participated in this study signed an informed consent form and volunteered to participate in this study.

Statistical Analyses

The survey data of this study were checked and entered into Epidata 3.1 by two researchers, and the data were statistically analyzed using SPSS 25.0, with descriptive statistical analysis using frequency counts, means, and constitutive ratios; the importance rating score was used to reflect the nurses' agreement with the indicators.

Results

Demographic Data

A total of 259 nurses were surveyed in this study. Through two-person verification, six questionnaires with apparent regularity or invalid questionnaires with logical confusion before and after were excluded, and 253 valid questionnaires were obtained. Among the surveyed study subjects, 72.7% were female, the age of the survey subjects was ≤40, accounted for the most significant percentage of nurses (92.4%); the majority of the study subjects had a bachelor's degree (85.8%); the department was a comprehensive ICU (88.5%); the proportion of nurses with 6–10 years of ICU experience (32.4%) was relatively large, which indicated that the structure of the nursing staff was reasonable. Still, the majority of the nurses (67.9%) had lower professional titles. Among them, 57.3% of the study subjects were non-ICU specialized nurses. Table 1.

Knowledge Sources of Sensitive Indicators of Quality of Care for ECMO Patients for ICU Nurses in Guizhou Province

The main ways for ICU nurses to acquire the knowledge related to the sensitive indicators of quality of care for ECMO patients are journals and magazines, public magazines, special lectures or academic conferences, and departmental training. The results of the study showed that 79.1% of the nurses had not participated in the training and courses related to the evaluation indexes of the quality of care for ECMO patients. The main way for ICU nurses to acquire the knowledge related to the sensitive indexes of the quality of care for ECMO patients was the departmental training, which

Table 1 Basic Information on Survey Respondents (n=253)

Characteristic		n	%
Gender	Male	69	27.3%
	Female	184	72.7%
Age, years	≤30	117	46.2%
	31–40	117	46.2%
	41–50	18	7.1%
	≥51	1	0.4%
Educational level	College degree	30	11.9%
	Bachelor degree	217	85.8%
	Master degree or above	6	2.4%
Professional title	Nurse	13	5.1%
	Nurse Practitioner	159	62.8%
	Nurse-in-charge	72	28.5%
	Associate chief nurse and above	9	3.6%
Departments	Comprehensive ICU	224	88.5%
	Specialized ICU	29	11.5%
Years of experience in ICU	<3	33	13.0%
	3–5	67	26.5%
	6–10	82	32.4%
	>10	71	28.1%
ICU specialized nurse	Yes	108	42.7%
	No	145	57.3%

Table 2 Sources of Knowledge on Sensitive Indicators of Quality of Care for ECMO Patients Among ICU Nurses in Guizhou Province, China

Characteristic		n	%
Attended training on ECMO patient care quality evaluation indicators	Yes	53	20.9%
	No	200	79.1%
Attended a course on ECMO patient care quality evaluation indicators	Yes	53	20.9%
	No	200	79.1%
Access to knowledge on indicators for evaluating quality of care for ECMO patients	Journals and Magazines	85	33.6%
	Public number	117	46.2%
	Lectures or academic conferences	91	36%
	Departmental training	221	87.4%

accounted for 87.4% of the total, and the other ways, in descending order, were the public number, the matic lectures or academic conferences, and periodicals and journals, which are shown in Table 2 for more details.

A System of Sensitive Indicators of Quality of Care for ECMO Patients and Nurses' Evaluation Scores

The results suggest that the top five importance scores of ECMO patients' care quality sensitivity indexes were Piping installation pass rate (4.48±0.81), ECMO nursing Operations Process and Pipeline precharge self-circulation pass rate (4.48±0.77), Deactivation success rate (4.38±0.86), Rate of implementation of decommissioning tests and Adverse events of care during ECMO support (4.37±0.89), Implementation rate of early rehabilitation exercises and ECMO-related complications (4.32±0.88). Among them, the importance evaluation scores of each index ranged from 4.01 to 4.48, and only the evaluation scores of the implementation of pre-membrane and post-membrane blood gas monitoring were lower than 4.10. as detailed in Table 3.

Table 3 253 Importance of ICU Nurses' Indicators of Sensitivity to Quality of Care for ECMO Patients Evaluation Score (Points)

Indicator	MIN	MAX	Importance Evaluation Score ($\bar{x} \pm s$)
1.ECMO Nursing Operations Process	1	5	4.48±0.77
2.Emergency Response Plan for ECMO Emergencies in Different Scenarios	2	5	4.14±0.90
3.ECMO Multidisciplinary Team	2	5	4.21±0.83
4.ECMO team training and assessment implementation rate	2	5	4.21±0.87
5.ECMO Patient-Care Ratio	2	5	4.24±0.79
6.ECMO Instruments and Consumables on Standby Pass Rate	1	5	4.12±0.99
7.Compliance rate of the placement environment	1	5	4.10±0.92
8.Preoperative skin preparation and protection pass rate	1	5	4.28±0.90
9.Preoperative blood transfusion preparation pass rate	2	5	4.24±0.76
10.Implementation rate for pressure monitoring of oxygenator imports and exports	2	5	4.21±0.94
11.Intubation accuracy	1	5	4.28±0.90
12.Piping installation pass rate	1	5	4.48±0.81
13.Pipeline precharge self-circulation pass rate	1	5	4.48±0.77
14.Implementation rate for monitoring of water tank temperature 36.5–37°C	2	5	4.24±0.76
15.ECMO parameter monitoring implementation rate	2	5	4.13±0.82
16.Implementation rate of pre- and post-membrane blood gas monitoring	2	5	4.01±0.92
17.Correct rate of hemodynamic monitoring	2	5	4.13±0.82
18.ECMO Contraindications and Indications Evaluation Rate	1	5	4.10±0.92

(*Continued*)

Table 3 (Continued).

Indicator	MIN	MAX	Importance Evaluation Score ($\bar{x} \pm s$)
19.Skin integrity assessment rate	2	5	4.21±0.83
20.Sedation and analgesia assessment rate	2	5	4.14±0.90
21.Rate of circulatory perfusion assessment of limb blood flow	2	5	4.21±0.87
22.Rate of assessment of neurological changes	2	5	4.24±0.79
23.Anticoagulation effect compliance rate	2	5	4.18±0.87
24.Pipeline maintenance compliance rate	2	5	4.24±0.89
25.Rate of implementation of decommissioning tests	1	5	4.37±0.89
26.Implementation rate of early rehabilitation exercises	2	5	4.32±0.88
27.Early Nutrition Implementation Rate	2	5	4.26±0.92
28.Adverse events of care during ECMO support	1	5	4.37±0.89
29.ECMO-related complications	2	5	4.32±0.88
30.Deactivation success rate	1	5	4.38±0.86

Table 4 Scores of Dimensions and Overall Scores of the Cognitive Evaluation of Sensitive Indicators of Quality of Care for ECMO Patients (n=253)

Dimension	MIN	MAX	Total Score ($\bar{x} \pm s$)	Mean Score ($\bar{x} \pm s$)
Structural indicator dimension	9	28	29.50±4.75	4.21±0.68
Process indicator dimension	18	40	84.77±11.72	4.24±0.59
Outcome indicator dimensions	11	30	13.07±2.21	4.21±0.68
Total cognitive evaluation score	73	150	127.34±18.10	4.24±0.60

Evaluation of ICU Nurses' Perceptions of Sensitive Indicators of Quality of Care for ECMO Patients in Guizhou Province, China, in Terms of Scores on Each Dimension and Overall Scores

ICU nurses in Guizhou Province, China, evaluated the highest and lowest scores of 150, 73, and had a total score of (127.34±18.10) points for their cognitive evaluation of quality of care indicators for ECMO patients, with an entry mean score of (4.24±0.60); The total scores for the structural indicator dimension, process indicator dimension and outcome indicator dimension were (29.50±4.75), (84.77±11.72) and (13.07±2.21) respectively; The three dimensions were ranked according to the average scores of the entries from the highest to the lowest, in which the highest scores were given to the Process indicator dimension, structural indicator dimension and Outcome indicator dimensions were relatively low. The detailed scores are shown in Table 4.

Discussion

Nurses' Access to Knowledge of Sensitive Indicators of Quality of Care for ECMO Patients

The results of this study showed that only 20.9% of nurses had attended training and courses related to the evaluation indicators of quality of care for ECMO patients. The results of this study are similar to the findings of scholars such as Liu Qingwei, whose findings indicated that only 48.80% of the 584 ICU nurses had participated in training related to ECMO.[28] The relatively low percentage of ICU nurses participating in training in the results of this study may be due to the fact that Guizhou Province in China is located in the southwest region, where ECMO care is still in the preliminary stage of exploration, and lacks a training system related to sensitive indicators of the quality of care for ECMO patients.

However, previous studies have shown that the application of ECMO as an advanced life support device and the related training have been increasingly emphasized.[29,30]

With the progress of society as well as the development of medicine, people's demand for health services is increasing, and the requirements for hospital quality management are also getting higher and higher. Nursing, as an important part of hospitals, the level of its management and the quality of care are not only important markers for measuring the quality of medical services, but can also directly affect patient outcomes. Some studies have shown that nursing staff account for 53% of the ECMO team and play a very important role in tube placement, operation and management of ECMO instruments, monitoring of ECMO patients' condition, and patient transfer,[12,31] and that the nursing staff's knowledge of the relevant knowledge will affect the patient's prognosis. Therefore, exploring the current status of ICU nurses' knowledge of ECMO patient care quality evaluation indicators is the basis for improving the quality of care for ECMO patients.[32,33]

Therefore, it is particularly important to strengthen the systematic training of knowledge related to sensitive indicators of quality of care for ECMO patients. On the one hand, Nursing managers should strengthen the investment and support of continuing education for in-service nurses, carry out systematic training on a regular basis, and constantly update the training methods and contents with the latest clinical practices and guidelines at home and abroad. On the other hand, nurses should take the initiative to strengthen the knowledge related to sensitive indicators of nursing quality for ECMO patients.

Analysis of the Current Status of Nurses' Knowledge of Sensitive Indicators of Nursing Quality

The results (Table 3) of this study indicates that the evaluation score of ICU nurses' sensitivity to the indicators of quality of care of ECMO patients in Guizhou Province is moderate; this may be related to the fact that the study subjects are all ICU clinical nursing staff in Guizhou Province due to their busy daily clinical work, relatively limited sources of knowledge, and insufficient scientific research thinking and literature search ability, and do not pay enough attention to and understand the latest published guidelines, clinical practice standards and other cutting-edge nursing knowledge and research hotspots both at home and abroad. In this study, the main ways of acquiring knowledge related to sensitive indicators of quality of care for ECMO patients were departmental training, public websites, special lectures or academic conferences, journals and magazines, and so on. Previous studies have shown that the quality and effectiveness of department-related training cannot be effectively controlled,[34,35] such as insufficient depth and lack of systematic training in the department. In addition, most hospitals only stop the quality of care in the search for clinical problems and the proposal of corrective measures, nursing staff can not effectively grasp the connotation and use of nursing management tools, resulting in scientific and effective nursing management is difficult to improve the quality of care in a sustained manner.[36]

Therefore, in response to the results of this study, first of all, the hospital management should fully understand the training needs of nurses, further deepen the reform of the training system, training forms, training content, and build a nursing talent team suitable for their own development should establish a systematic, scientific, and comprehensive training system to improve the nurses' enthusiasm for learning the sensitive indicators of the quality of care of patients with ECMO, and then better use the theory in practice to improve the quality of patient care.[37] Secondly, the department can organize a training group on the quality of care for ECMO patients or organize ECMO specialist group members to go to hospitals with rich experience in ECMO for learning, and then focus on training for the specialist group members, who will then popularize it to the nursing staff of the whole department; Finally, the medical staff should give full play to their subjective initiative, strengthen the knowledge of the national policy and related literature, and expand the knowledge of ECMO-related indicators.[35] Medical staff should give full play to their initiative, strengthen their knowledge of national policies and related literature, expand their knowledge of ECMO, lay a good foundation for better care of ECMO patients, and then promote the development of ECMO specialty care.

Previous studies have shown that there is no consensus on the importance of Process indicator as well as outcome indicator dimensions.[38] Some scholars have been shown that process indicators tend to be prioritized over outcome

indicators, but do not replace outcome indicators, as process indicators are easier to measure as well as improve compared to outcome indicators, and that strengthening quality control of process indicators can help to improve patient outcomes.[39] Other scholars have shown that outcome indicators are a direct reflection of the improvement of patients' health status by the control of the nursing process, and that outcome evaluation is more direct and objective compared to process indicators.[40] The results of this study indicate that process evaluation have the greatest impact on the quality of care for ECMO patients, and the results of this study (Table 4) are consistent with those of previous studies.[24] This indicates that the process dimension is more important than the structural dimension and outcome dimension in the evaluation of the quality of care for ECMO patients, and also indicates that nursing care should not only focus on the evaluation of the outcome dimension, but also focus on the evaluation of the process dimension, which can help the clinical staff to anticipate the risk factors as early as possible, and to take interventions as early as possible, so as to reduce the patients' complications, and at the same time may lay a foundation for the improvement of the quality of care for the patients. This also suggests that clinical caregivers should pay attention to the various indicators in the care of ECMO patients, and at the same time, continuously adjust and improve the content of nursing services and related operational procedures, and implement the concept of patient-centered service.

Improvement of ECMO Patient Care Quality Education and Training System

With the transformation of the medical model and the development of specialized care, nursing managers are paying more and more attention to the evaluation of the quality of care for ECMO patients Quality of care, as one of the most important representatives of a hospital's level of management and service, is closely related to the patient's prognosis and quality of life, and the quality of care evaluation indexes are used to evaluate the quality of a hospital's service and management, and thus respond to the quality of care assessment tools.[41] The main actors of nursing quality are mainly nursing staff, but at present, the developers and implementers of the evaluation indexes of nursing quality in domestic specialties are nursing managers.[42]

Therefore, the personnel structure of nursing quality evaluation indicators should be extended from nursing managers to clinical nurses, fully mobilize the subjective initiative of nursing personnel, encourage nurses to actively participate in the quality control process, provide systematic and structured training courses or go to hospitals with rich experience in specialty care for training, improve the nurses' cognitive level of nursing care quality evaluation, and then improve their behavioral compliance. In response to the problems identified in the nursing process, the effectiveness of nursing quality control is assessed, barriers and facilitators to sustainability are explored, and response programs are developed to promote the continuous improvement of nursing quality.[43] In addition, we can also learn from the experience of foreign nursing quality management, such as learning from the US nursing quality index database, constructing a localized database of specialty nursing quality evaluation indexes, analyzing the data through the network platform, and dynamically monitoring the weaknesses and strengths of the specialty nursing quality management, so as to promote the continuous improvement of the quality of specialty nursing care.[44,45]

Limitations

Due to the restrictions on human and material resources, the scope of the survey only involved hospitals carrying out ECMO technology in the Guizhou Province of China. It did not involve ICU nurses from other provinces, and the study results may be limited. In future studies, a large-sample, multicenter study can be conducted to expand the scope of the study further to comprehensively understand the current status of nursing staff's knowledge and evaluation of sensitive indicators of quality of care for ECMO patients in China, and then improve a realistic basis for the development of relevant training for ICU nurses to improve the level of nursing care management of ECMO patients in hospitals.

Conclusion

The results of this study showed that ICU nurses in Guizhou Province, China, rated their knowledge of most ECMO patient care quality with evaluation indicators as moderate, and departmental training was the source of most nurses' knowledge related to sensitive indicators of ECMO patient care. In the future, hospital administrators should provide systematic, scientific, and homogenized training and establish a perfect quality control system to improve the cognitive

evaluation level of ICU nursing staff in Guizhou Province, china. It lays a solid foundation for the clinical application of nursing managers.

Acknowledgments

We are grateful to the 10 hospitals in Guizhou Province, China, that have implemented ECMO technology, to the Affiliated Hospital of Guizhou Medical University for its support in data acquisition, and to all the organizations that provided meteorological data.

Funding

This study was supported by the project of Guizhou Provincial Health Commission (gzwkj2024-256) and the project of the Nursing Department of the Affiliated Hospital of Guizhou Medical University (gyfyhl-2023-A17).

Disclosure

The authors report no conflicts of interest in this work.

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