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Research on the Application of Evidence-Based Quality Control Circle to Improve the Implementation Rate of Airway Management Measures in Adult Critically Ill Patients

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Abstract

Objective: To explore the effect of evidence-based quality control circle (QCC) in improving the implementation rate of airway management measures in adult critically ill patients. **Methods**: Based on the Joanna Briggs Institute (JBI) evidence-based health care model, the best evidence of airway management in adult critically ill patients was obtained and applied to the clinic. **Results**: The total implementation rate of airway management measures in adult critically ill patients increased from 23.62% before the implementation of quality control circle to 88.82%, and the pulmonary infection rate in critically ill patients decreased from 42.31% to 21.74%, with statistical significance between the two groups ($P < 0.05$). The sputum characteristics of patients were significantly improved before the application of evidence ($P < 0.05$). The length of hospital stay in NICU was shortened, which had positive significance to a certain extent, but there was no statistical significance between the two groups ($P > 0.05$). **Conclusion**: Evidence-based quality control circle activities can standardize the practice standards of airway management in critically ill patients, reduce the occurrence of patients' airway related complications, and improve clinical outcomes.

Keywords

Critically Ill Patients, Airway Management, Be Evidence-Based, Quality Control Circle, Intensive Care Unit (ICU)

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1. Introduction

Poor airway management in critically ill patients will lead to related complications, aggravate the original condition of patients, make it difficult to take ventilators offline, prolong hospital stay, and increase treatment costs [1] [2] [3]. Airway management is an important part of basic treatment in intensive care unit, and is of great significance in maintaining patient safety and improving prognosis [4]. In 2016, the relevant regulations [5] issued by the National Health and Family Planning Commission emphasized that the management of artificial airways in intensive care units should be strengthened, the continuous improvement of nursing quality should be promoted, and the treatment effect of patients should be improved. Foreign scholars have conducted prospective studies on the main complications of airway management in intensive care units, and relevant data show that the quality of airway management is not optimistic [6]. At present, some relevant consensus has been introduced in domestic clinical practice, but clinical nursing staff have insufficient cognition and poor compliance, limited to the summary of clinical experience, and lack of evidence-based management norms. With the deepening of medical reform, major hospitals take strengthening quality construction as an important task of hospital construction. As a quality management tool, quality control circle has become an important tool for hospital quality management [7]. However, other researchers have shown that the quality control circle lacks a certain scientific nature [7] [8]. Therefore, based on the evidence, this study systematically searched and summarized the best evidence of airway management in adult critically ill patients, determined review indicators and review methods, and then formulated action strategies conducive to the implementation of airway management measures in adult critically ill patients.

2. Methods

2.1. Research Object

A total of 98 patients who met the inclusion criteria and were admitted to the neurosurgical care unit of a top-three hospital in Jingzhou City from December 1st, 2019 to December 31st, 2020 were selected, and 52 patients before the quality control circle activity were selected as the observation group according to the time of quality control circle activity from December 1, 2019 to August 31, 2020. A total of 46 patients after quality control circle activities from September 1, 2020 to December 31, 2020 were selected as the test group. Inclusion criteria: 1) age ≥ 18 years; 2) Patients with artificial airway established after admission to intensive care unit; 3) Stay in intensive care unit ≥ 4 days after the establishment of artificial airway; Exclusion criteria: 1) Patients with severe respiratory diseases;) 2) Patients admitted to the intensive care unit with severe lung infection; 3) Patients with rapid progression of disease changes and intermediate death; 4) Patients who are discharged automatically. There was no significant difference in gender, age, etiology and GCS score between the two groups at admission (P >

0.05), and the baseline was consistent and comparable, as shown in Table 1.

2.2. Research Methods

2.2.1. Set up a Quality Control Circle Team

It is composed of 12 people voluntarily, including 1 director of nursing department, 1 deputy chief physician of the department, 1 specialist head nurse, 6 neurosurgical medical staff and 3 nursing graduate students. A teacher in the department served as the circle leader, and the deputy chief physician and head nurse of the neurosurgical ICU served as counselors. Through brainstorming and democratic voting, all members of the circle determined that the theme of this activity was "Improving the compliance rate of airway management strategies for adult critically ill patients". The quality control Circle conducted activities from September 1, 2020 to December 31, 2020, once a week, and a total of 46 cases were investigated.

2.2.2. Problem Finding and Analysis

1) Identify care issues: What is the best evidence for evidence-based airway management strategies for critically ill adults? Whether the best evidence for airway management strategies in critically ill adults is consistent with current clinical status; If not, how can the best evidence be applied to the clinic? 2) Analysis of reasons: The implementation of airway management measures for adult critically ill patients from December 1, 2019 to August 31, 2020 was analyzed. The members of the circle group conducted true cause analysis and fishbone diagram analysis from four aspects: human, physical, legal and environmental, and found that the main influencing factors were: 1) Nurses lacked relevant knowledge of airway management for critically ill patients, and artificial airway lacked understanding of airway management guidelines. 2) There is no uniform airway management standard in the department, and the relevant nursing procedures and rules and regulations are lacking. 3) Nurses are busy, the implementation and record of standardization increase the workload of nurses,

Table 1. Comparison of general data between the two groups.

Project		observation group (n = 52 cases)	experimental group (n = 46 cases)	Statistical	value P
Sex	Male	37	36	0.649[1)]	0.421
	Female	15	10		
Age		57.52 ± 12.72	56.26 ± 11.82	0.508[2)]	0.613
Etiology	Severe brain injury	11	16	2.58[1)]	0.487
	Subarachnoid hemorrhage	10	9		
	Basilar hemorrhage	11	8		
	Other	20	13		
GCS score on admission		7.96 ± 3.27	7.91 ± 3.44	0.71[2)]	0.94

Note: 1) X^2, 2) t.

and nurses have resistance psychology. 4) Departments do not pay enough attention to airway humidification management. 5) Doctors do not pay enough attention to airway management and the cooperation is not high, and the leadership of managers is insufficient. 6) The department did not introduce products such as subglottic catheter and mouthwash for patients with ventilators.

2.2.3. Formulation of Improvement Measures

1) Retrieving evidence

Top-down retrieval based on the "6S evidence resource pyramid model" [9] Computer searches were used for Up To Date, Joanna Briggs Institute(JBI) Centre for Evidence-based Health Care database, British Medical Journal (BMJ), National Guideline Clearinghouse (NGC), society of critical care medicine (SCCM), UK National Insitute for Healthcare Excellence Health and Care Excellence (NICE), Cochrane library, Cumulative Index to Nursing and Allied Health Literature, CINAHL), Medline, PubMed, China Biomedical Literature Database, CNKI, and Wanfang database on airway management in adult critically ill patients, including advanced clinical decision support, guidelines, systematic reviews, evidence summaries, and expert consensus. Inclusion criteria: The subjects were critically ill patients ≥ 18 years old with tracheal intubation or tracheotomy; Exclusion criteria: non-adult patients were excluded, grey literature, original studies, incomplete studies, and studies with low literature quality evaluated by literature quality. The guidelines adopt the AGREE II [10] evaluation scale, an evaluation tool developed by an international cooperative organization, the JBI evidence-based Health Care Center quality evaluation tool [9] for systematic evaluation and expert consensus, and the quality evaluation of advanced clinical decision-making and evidence summary can be traced back to the original literature on which the evidence is based. According to the type of literature, the corresponding evaluation tools are selected for quality evaluation. The strength of evidence recommendation was determined based on the JBI 2014 evidence recommendation level [9] judgment criteria.

2) Formulating Measures

Invite hospital stakeholders to evaluate the FAME [9] of the evidence, namely, the Feasibility, Appropriateness, Meaningfulness and Effectiveness of the evidence, and screen the evidence. 29 pieces of evidence were obtained. Based on the characteristics of departments, 20 localization quality review indicators were determined, as shown in **Table 2**. Airway evaluation, airway suction timing, air bag management, airway humidification, airway suction, air incision stoma care, oral care and other seven aspects were used as review indicators and improvement measures. Improvement measures: 1) Conduct the best evidence interpretation meeting for airway management in adults with critical illness in the department to interpret the source, level, recommendation strength and specific connotation of the evidence in detail, so that the nurses in the department have a full understanding of the evidence of airway management and strengthen the awareness of airway management; 2) Organize and carry out special training on

Table 2. Evidence-based nursing review indicators and review methods for airway management in adult critically ill patients.

Review indicators
Indicator 1. The patient's tracheostomy wound appears red, tender, swollen, inflammation, smell, high skin temperature, yellow-green secretions can be seen around the stoma, or the patient has fever, the nurse immediately informs the doctor.
Indicator 2. The patient has signs of infection at the tracheostomy site, follow the doctor's advice for bacterial culture.
Indicator 3. When the patient has decreased blood oxygen saturation, decreased blood oxygen partial pressure, frequent coughing and respiratory distress, the nurse should perform airway suction for the patient.
Indicator 4. When the patient needs to suck sputum, the airway pressure is low and the spontaneous breathing is weak, increase the cuff pressure appropriately.
Indicator 5. After the patient turns over, wipes the bath, and transfers, the nurse should re-measure the cuff pressure.
Indicator 6. Patients who have established artificial airways undergo continuous oxygen humidification and follow the doctor's instructions to inhale 2 - 3 times per day.
Indicator 7. The artificial airway humidification fluid uses 0.45% sodium chloride solution for continuous airway humidification.
Indicator 8. When the patient has sputum in the airway, it should be sucked in time, and the sputum suction time is ≤15 s. Patients with no sputum or little sputum should perform a suction at least 8 hours.
Indicator 9. Oral suction before turning over and after oral care.
Indicator 10. Establishment of artificial airway patients use subglottic suction tracheal tube.
Indicator 11. Use special tracheostomy gauze when changing dressings for tracheostomy wounds, and keep the skin at the tracheostomy site dry.
Indicator 12. Patients with mechanical ventilation use chlorhexidine mouthwash for oral care once for 6 h - 8 h.
Indicator 13. The nurse evaluated the skin of the patient daily and kept the wound clean and dry and replaced at any time in case of contamination.
Indicator 14. Use a manual measurement cuff pressure gauge to monitor the airbag pressure every 6 - 8 hours and maintain it at 20 - 30 cm H_2O. The inflation pressure should be higher than the ideal value 2 cm H_2O during each measurement.
Indicator 15. When monitoring the cuff pressure, clean the water in the pressure measuring tube in time.
Indicator 16. The nursing class monitors and records the cuff pressure once after the tracheotomy wound dressing is changed.
Indicator 17. Cuff pressure monitoring cannot use finger touch to determine the degree of inflation.
Indicator 18. Nurses regularly evaluate airway humidification and adjust dynamically.
Indicator 19. The patient has a large amount of secretions in the airway and the nurse needs to perform deep suction.
Indicator 20. The nurse needs to measure the length of the suction tube inserted into the patient's airway before suctioning 1) Insert into the carina and retract the suction tube 1 - 2 cm 2) Measure the same tracheal tube to estimate the length of the suction tube.
Indicator 21. The nurse pre-oxygenated the patient with pure oxygen for at least 30 seconds before and after suction.

adult critical airway management, and incorporate its contents into the pre-job training plan, establish a systematic training plan and conduct post-training assessment. 3) To carry out literature retrieval training courses to improve nursing staff's literature retrieval ability and update clinical knowledge in a timely and scientific manner; 4) Develop airway management and nursing routine for adult critically ill patients in the ICU, airway management flow chart for adult critically ill patients, teaching videos and Manual for Artificial Airway Management in the ICU, hold regular trainings and push them to the wechat group, send the electronic version to the wechat group, and place the paper version in the nurse station for online and offline learning by nurses. 5) The department is equipped with a mobile nurse station beside the bed to facilitate the operation of nursing staff and reduce workload. 6) Establish an airway management team, take responsibility for people, and set up a PDCA quality improvement project for airway humidification of critically ill patients. 7) By moving into the new hospital equipment introduction plan, the introduction of subglottic catheter, humidification device and other products. 8) The new technology and new business in the department actively organize medical staff to participate, improve their sense of participation, and increase the atmosphere of medical cooperation; 9) Explain the benefits of chlorhexidine mouthwash to the patient's family, and inform the patient's family to buy the correct chlorhexidine mouthwash.

2.3. To Strengthen the Quality Control of Airway Management Measures Implemented in Adult Critically Ill Patients

A three-level quality control "head nurse - responsible group leader - responsible nurse" was established in the ward to ensure the effective implementation of airway management measures. Develop a quality review form, and the responsible group leader shall register the implementation of 20 measures every day. Before leaving work every day, the responsible group leader will give feedback to the group leader on the problems existing in the implementation of the measures on that day. The head nurse will organize the nurses in the department to analyze the reasons in the morning meeting on the second day, and organize the quality control circle members to discuss and analyze the existing problems every week and propose improvement measures. At the same time, the quality control circle members to share the experience and harvest.

2.4. Evaluation Indicators and Data Collection Methods

2.4.1. Implementation Rate of Airway Management Measures in Adult Critically Ill Patients

The implementation rate of airway management measures for adult critically ill patients refers to the ratio of the number of items correctly implemented by nurses to the total number of items in the practice of implementing airway management measures for adult critically ill patients. Make a registration form for indicator review. The responsible nurse records the implementation of the work every day, the responsible group leader supervises and follows up, and the head

nurse collects statistics.

2.4.2. Pulmonary Infection Rate

The patient has cough, thick sputum, wet lung sound, and one of the following can be diagnosed: 1) Increased white blood cells and (or) neutrophils; 2) Fever symptoms; 3) X-ray or CT showed inflammatory changes in the lungs [11]. Data were collected by consulting medical records and nursing records.

2.4.3. Length of Stay in Intensive Care Unit

Total number of days in ICU from the first day of admission to the ICU to the day of departure. Data were collected by consulting medical records and nursing records.

2.4.4. Sputum Character

Sputum characteristics of patients on the fourth day after the artificial airway was established were collected through on-site observation records, medical records and nursing records. The characteristics of sputum can be divided into three levels according to the viscosity [12] [13]: 1) Grade I: sputum is like foam or rice soup, and there is no retention of sputum on the inner wall of the suction tube after negative pressure suction; 2) degree II: thicker than degree I, a small amount of retention in the inner wall of the suction tube after negative pressure suction, easy to be washed; Third degree: yellow, obviously viscous, sputum tube inner wall is easy to retain a lot of sputum, not easy to wash, sputum tube is easy to collapse when the negative pressure is too large.

2.5. Statistical Methods

SPSS 21.0 software was used for statistical analysis. Counting data were expressed by frequency and percentage, and comparison between groups was performed by X^2 test. The measurement data were represented by mean ± standard deviation, the comparison between groups was performed by t test, the rank data was performed by non-parametric test (Mann-Whitney U test), and all statistical tests were performed by bilateral test with the test level $\alpha = 0.05$.

3. Results

3.1. Tangible Results

3.1.1. Comparison of the Implementation Rate of Airway Management Measures in Critically Ill Patients between the Two Groups

The total implementation rate of airway management measures in adult critically ill patients increased from 23.62% before the development of quality control circle to 88.82%, and the compliance rates of all measures were significantly higher than those before the development, with statistical significance ($P < 0.05$), as shown in **Table 3**.

3.1.2. Comparison of Pulmonary Infection Rate and Length of Stay in NICU between the Two Groups

Before the implementation of quality control circle, the pulmonary infection rate

of 52 critically ill adult patients with airway management was 42.31%, and the length of hospitalization in NICU was 11.67 ± 5.50 days. After the implementation of quality control circle, the incidence of pulmonary infection in 46 critically ill patients with airway management was 21.74%, and the length of hospital stay in NICU was 10.00 ± 4.91 days. The results of pulmonary infection between the two groups before and after the implementation of quality control circle were statistically significant ($P < 0.05$). There was no significant difference in hospitalization days between the two groups ($P > 0.05$), as shown in Table 4.

3.1.3. Comparison of Sputum Characteristics between the Two Groups

Before the quality control circle was carried out, 4 cases of grade I, 28 cases of grade II and 20 cases of grade III sputum were included in 52 patients. After the quality control circle was carried out, 33 patients with degree I, 13 patients with degree II and 0 patients with degree III were included. The results showed that there were statistical differences in the results of sputum traits before and after the development of quality control circle ($P < 0.05$), as shown in Table 5.

Table 3. Comparison of the implementation rate of airway management measures in critically ill patients between the two groups.

Project	Observation group (n = 52)		Experimental group (n = 46)		X^2	P
	Number of cases	Percentage (%)	Number of cases	Percentage (%)		
Airway assessment compliance rate	10	19.23	40	86.95	44.801	0.000
Airway suction timing execution coincidence rate	16	30.77	44	95.65	43.283	0.000
Airbag management compliance rate	24	46.15	46	100	34.677	0.000
The compliance rate of airway humidification	12	23.07	43	93.47	49.127	0.000
Airway suction execution accuracy	20	38.46	40	86.95	24.179	0.000
Coincidence rate of nursing management of gas incision stoma	4	7.69	38	82.61	55.938	0.000
Oral care implementation compliance rate	0	0	35	76.09	61.546	0.000
Total compliance rate for all projects	86	23.62	286	88.82	292.562	0.000

Table 4. Comparison of incidence of pulmonary infection and length of stay in NICU between the two groups.

Group	Number of cases	Pulmonary infection rate [example (%), %]	Length of stay in NICU Time (d, x ± s)
Observation group Statistical	52	22 (42.31)	11.67 ± 5.50
Experimental group	46	10 (21.74)	10.00 ± 4.91
value		4.696[1)]	1.579[2)]
p-value		0.030	0.118

Note: 1) X^2, 2) t.

Table 5. Comparison of sputum characteristics between the two groups.

Group	Number of cases	Sputum character [example (%), %]		
		I degree	II degree	III degree
Post application of evidence	52	4 (7.69)	28 (53.85)	20 (38.46)
Post application of evidence	46	33 (71.74)	13 (28.26)	0
z-value			−6.860	
p-value			0.000	

3.2. Intangible Results

Evaluation of activity ability of circle members before and after activities

Through the implementation of evidence-based quality control circle activities, the implementation rate of airway management measures in adult critically ill patients can be improved, and the expected goal can be achieved. Circle members evaluate the situation. After carrying out quality control circle activities, Circle members complete self-rating according to the evaluation project. The maximum score of each evaluation item is 5 points. The total score and average score are calculated, and the evaluation map is drawn at the same time. The score of intangible achievements is shown in Table 6 and Figure 1.

4. Discussion

4.1. Evidence-Based Quality Control Circle Can Improve the Implementation Rate of Airway Management Measures in Adult Critically Ill Patients

In this study, the evidence-based quality control circle combined with multidisciplinary cooperation was adopted, and the circle group jointly found the problems and analyzed the causes, and formulated the implementation plan. After implementation, the total implementation rate of airway management measures for adult critically ill patients was 88.82%, and the implementation rate of various review measures was 76.09% - 100%, with significant improvement effect. It is suggested that in the process of using quality management tools, evidence-based theory can be used as a guide to make management more scientific.

4.2. Evidence-Based Quality Control Circles Can Reduce the Incidence of Airway Management-Related Complications in Critically Ill Adults

As can be seen from the results in Table 4, the number of days of hospitalization in NICU of patients after quality control circle activities was shortened, which had positive significance to a certain extent, but there was no statistical significance in the comparison between the two groups ($P > 0.05$). Due to the COVID-19 epidemic and limited study time, the sample size was not large, resulting in no significant difference before and after quality control circle activities. Multidisciplinary collaboration can change the traditional nursing concept of nurses,

Table 6. Intangible Achievements rating table (score).

Serial number	Evaluation item	Before the event		After activity		Activity growth	Positive/ negative
		total	average	total	average		
1	Sense of responsibility	30	2.50	39	3.25	+0.75	↑
2	Enthusiasm	26	2.17	46	3.83	+1.66	↑
3	Sense of honor	29	2.41	47	3.92	+1.51	↑
4	Team spirit	24	2.00	42	3.50	+1.00	↑
5	Degree of harmony	37	3.08	49	4.08	+0.75	↑
6	Courage to face problems	40	3.33	49	4.08	+0.75	↑
7	Communication and coordination	36	3.00	40	3.33	+0.33	↑
8	Knowledge of quality control techniques	39	3.25	48	4.00	+0.75	↑

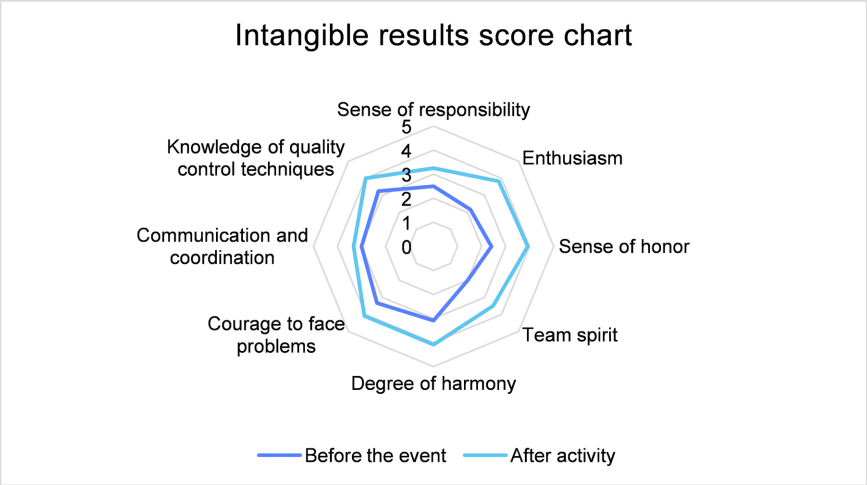

Figure 1. Intangible results evaluation chart.

develop innovative thinking, enhance the initiative of work, improve the quality of clinical nursing services, and thus reduce the incidence of airway management-related complications in critically ill patients.

4.3. Evidence-Based Quality Control Circle Can Improve the Comprehensive Ability of the Nursing Team

Evidence-based quality control circle activities can enable medical staff at different levels to organize together and participate in the nursing quality management of the department. The collision of thinking in different disciplines and the interweaving of different ideas have opened up the depth of knowledge of the staff and made continuous improvement of the nursing quality in the ward.

5. Summary

The implementation of evidence-based quality control circle activities has effec-

tively improved the implementation rate of airway management measures, reduced the incidence of complications related to airway management, reduced treatment costs, and improved the clinical outcomes of patients. This study still has some shortcomings. In the process of promoting the activity, due to the impact of the novel coronavirus epidemic, the number of patients admitted has decreased, resulting in a small number of samples before and after the application of evidence. If further promotion is to be carried out, more practice wards should be added, the sample size should be further increased, and the continuous improvement of nursing quality should be maintained.

Author Statement

Yan Yujiao participated in the design, data analysis and writing of the paper. Wu Jing participated in the conception, revision and translation of the paper. Liu Juan participated in the project process guidance. Yuan Yanting, Liu Lixin and Ding Juan participated in the data collection and collation. Ye Huaxin participated in the promotion of the project process.

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Ethical Consideration

Ethical approval or individual consent was not applicable.

Patient Informed Consent Statement

No need to seek patient consent.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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