Hindawi
Scientific Programming
Volume 2021, Article ID 3485058, 6 pages
https://doi.org/10.1155/2021/3485058

Research Article

Design of Breakdown and Checklist for Continuous Renal Replacement Therapy

Shujuan Wang, Yan Kang, Xiaoqing Wang, Lanling Wei, Yanan Zhu, and Huilin Yuan

Qingdao Municipal Hospital Emergency Department, Qingdao Municipal Hospital, Qingdao 266011, China

Correspondence should be addressed to Xiaoqing Wang; led2913@163.com

Received 26 October 2021; Accepted 22 November 2021; Published 1 December 2021

Academic Editor: M Pallikonda Rajasekaran

Objective. This study aimed to improve the quality of continuous renal replacement therapy (CRRT). *Methods*. A pool of candidate indicators was established using literature retrieval, panel discussion, and experience summary. The first round of consultation was performed with the selected 18 experts by the Delphi method. Then, the checklist was modified according to the experts' opinions for the second round of consultation to prepare the final checklist. *Results*. The positivity coefficients of experts in the two rounds of consultation were 100% and 88.9%, respectively, with the authority coefficient of 0.88. The Kendall coordination coefficients of the primary and secondary indicators were 0.296 and 0.303, respectively ($P < 0.05$). Finally, the breakdown and checklist were prepared, which involved 16 primary indicators and 56 secondary indicators. *Conclusion*. The scientific and reasonable breakdown and checklist prepared based on a consultation can provide scientific guidance for nursing during CRRT, reduce the incidence of adverse events, and improve work efficiency and satisfaction of medical care.

1. Introduction

Continuous renal replacement therapy (CRRT), a continuous therapy for blood purification for around 24 hours a day to replace the damaged kidney, is the general term for continuously and slowly removing water and solutes [1]. Given the promising therapeutic effect and prognosis of CRRT, it has been widely used to treat critically ill patients. However, the multiple treatment modes have complicated the preparation and operation, bringing difficulties to homogeneous management in clinical work [2, 3]. In 2010, a total of 2.618 million people received renal replacement therapy (RRT) worldwide. It is estimated that by 2030, the number of people using RRT will be more than double to 5.439 million, with the highest growth rate in Asia (by 968,000 increased to 2.162 million) [4]. CRRT is the main approach for patients to maintain life, which can prolong the survival time and improve the quality of life. Meanwhile, CRRT has the characteristics of high technical content, substantial expertise, and high risk. Therefore, actively exploring intervention methods to improve the quality of CRRT care and developing a scientific and reasonable management plan are of practical significance to prolong the survival period of hemodialysis patients and improve the quality of life of patients. Therefore, we prepared the Breakdown and Checklist for CRRT to better cooperate with clinical work, improve the work efficiency, realize homogeneous management, and reduce the incidence of adverse events [5]. Their clinical application has obtained promising therapeutic effects, which are reported as follows.

2. Research Methods

2.1. Preliminary Design. A CRRT team was established to select the relevant literature articles about CRRT checklist from Chinese and English databases according to the research objectives and prepare an item pool for the breakdown and checklist according to the high-risk steps during operation and in combination with the clinical experience based on the adverse events of CRRT [6–9]. Four experts (two directors and associate chief physicians of the nephrology, one chief nurse, and one supervisor nurse) evaluated the rationality of the sorted pool, gave reasons for

adding or removing items, and prepared the initial lists, including the breakdown and checklist [10–13].

2.2. Preparation of Consultation Questionnaire. The consultation questionnaire was prepared according to the first draft of the revised breakdown and checklist (three parts): (1) letter to experts, in which the research objective, content, and significance were briefly introduced; (2) CRRT breakdown and checklist evaluation form, which was used to solicit expert opinions and suggestions on the setting and importance of the breakdown and checklist; (3) expert situation questionnaire, which was used to collect experts' general information, judgment basis, and familiarity with the research content.

2.3. Selection of Experts. The number of consultant experts should be determined based on the amount of research. It was reported [14] that the number of experts was generally set as 15–30 to ensure the reliability of the inquiry results. Inclusion criteria of consultant experts in this study: (1) the clinicians and nurses in grade A class three hospitals, with over 10 years of experience in the field of renal replacement therapy; (2) with the bachelor degree or above, intermediate title or above; (3) with sufficient understanding of the study and can actively complete the expert consultation; and (4) with a willingness to participate in this study, were included. After screening, 18 experts from 5 provinces and municipalities were selected.

2.4. Expert Consultation. The consultation questionnaire was prepared according to the initial breakdown and checklist and sent to 12 experts by e-mail or field distribution from January to May 2018 for two rounds of an expert consultation. The questionnaires of the first round were collected and analyzed based on the summarized expert opinions and suggestions. Then, the contents were adjusted and distributed for the second round of consultation to make the breakdown and checklist more scientific, reasonable, and consistent.

2.5. Statistical Methods. Excel 2016 and SPSS 19.0 were used for data analysis and calculation of expert positivity coefficient, authority, arithmetic mean of various indicators, coefficient of variation, and coordination coefficient of opinions. The coordination of opinions was expressed by the Kendall coordination coefficient. $P < 0.05$ was considered statistically significant. The indicators with the average score of importance and reliability >3 points, coefficient of variation <25%, and the full-score rate >20% were retained and then modified and selected through panel discussion based on expert opinions and comprehensive consideration of all scientific indicators.

3. Results

3.1. Basic Data of Experts. Basic data of the selected 18 experts are shown in Table 1.

Table 1: Basic data of experts.

General condition		Number	Proportion (%)
Age			
	30–40	3	16.7
	41–50	9	50.0
	≥51	6	33.3
Education background			
	Bachelor	10	55.6
	Master	5	27.8
	Ph.D.	3	16.7
Title			
	Intermediate	3	16.7
	Subsenior	9	50.0
	Senior	6	33.3
Years of working			
	10–20	2	11.1
	21–30	12	66.7
	≥31	4	22.2
Fields			
	Medicine	6	33.3
	Clinical care	9	50.0
	Administration	3	16.7

3.2. Expert Positivity Coefficient. The response rate of consultation questionnaire was used to calculate the expert positivity coefficient. As reported previously [15], the experts were considered highly positive when the expert positivity coefficient was higher than 70%. 18 questionnaires were released for either round of expert consultation, and 18 and 16 were collected in the first and second rounds, with the response rate of 100% and 88.9%, respectively, indicating high positivity of experts.

3.3. Expert's Authority. The expert's authority coefficient (Cr) was calculated based on the reason of judgment (Ca) and degree of familiarity (Cs). Generally, it is believed that the authority coefficient not lower than 0.7 can be acceptable [16–18]. The expert's authority coefficient in the first round of consultation was 0.85 (Ca = 0.89, Cs = 0.82), while Ca in the second round of consultation was 0.91 (Cs = 0.85, Cr = 0.88). The authority coefficients in both rounds were >0.7, indicating the high authority of the experts.

3.4. Coordination Degree of Opinions. The coefficient of variation and Kendall coordination coefficient were used to test the coordination of experts. The coefficients of variation were 0.03–0.36 and 0.00–0.23 in the first and second rounds of expert consultation, respectively, while the Kendall coordination coefficients were 0.296 and 0.303, respectively, showing statistical significance ($P < 0.05$).

3.5. Consultation Results. The items were classified as very important (5 points), important (4 points), general (3 points), unimportant (2 points), and very unimportant (1 point). The experts were asked to score according to the degree of importance and gave the corresponding opinions in the columns of "suggestions on revision" and "items

suggested to be added." The indicators with the mean score >3 points, coefficient of variation <25%, and full-score rate >20% were retained, then deleted, and modified based on expert opinions.

In the first round of consultation, the primary indicators had the mean value of importance of 3.28–5.00 points, the coefficient of variation of 0.082–0.181, and full-score rate of 10%–100%, which were 4.02–5.00, 0.000–0.284, and 30%–100% points, respectively, as for the secondary indicators. According to the screening conditions and expert opinions, the primary indicator "evaluation of hemofiltration tube" was merged into the primary indicator "preparation prior to operation."

According to the screening conditions, and in accordance with the experts' opinions and panel discussion, the primary indicator "evaluation of hemofiltration tube" was merged into "preparation prior to operation." The item "following the doctor's advice" under the secondary indicator "termination" was removed, and the secondary indicator "doctor's advice after termination" was added. The secondary indicators "date" and "wearing gloves" were removed. Moreover, "final treatment" and "evaluating patients' tolerance, and whether sedation or restraint is required" were added. As suggested by the experts, the warning signs "Caution: Use with caution in the case of liver dysfunction!" and "Note: Total calcium/free calcium >2.5 ⟶ citrate accumulation" was added.

In the second round of consultation, the average value of importance of the primary indicators was 4.12–5.00, the coefficient of variation was 0.000–0.208, and the full-score rate was 33.63%–100%, which were 3.85–5.00, 0.000–0.227, and 30%–100%, respectively, for secondary indicators. As suggested by the experts, the warnings were bolded in red. The item "evaluate the bleeding and coagulation of the patients" was changed to "check whether there are bleeding spots on the skin and mucosa and evaluate the bleeding and coagulation of the patients." Finally, the breakdown and checklist were prepared, which involved 16 primary indicators and 56 secondary indicators, respectively, whose consultation results are shown in Table 2.

4. Discussion

4.1. Reliability of Consultation Results. We performed two rounds of expert consultation based on document retrieval, clinical needs, and brainstorming of the CRRT team to ensure the scientificity and practicability of the breakdown and checklist. All the selected experts were familiar with the knowledge of CRRT and can provide clinical opinions combining theoretical and practical experience. The response rate of either round of consultation was 100%, and the suggestions on modification were given, indicating that the experts highly supported this study. In the first round of consultation, the expert's authority coefficients were 0.85 and 0.88 in the first round, both of which were larger than 0.7, indicating the high authority. After two rounds of consultation, the Kendall coordination coefficient of the secondary indicators was 0.303 ($P < 0.05$), indicating that the experts had high consistency on the contents of the breakdown and checklist, with only small divergences. Therefore, the consultation results of this study had a certain degree of reliability [16].

4.2. Scientificity of Consultation Results. In this study, the breakdown (involving 11 items of patient information, evaluation prior to operation, treatment mode, pipeline preflushing, anticoagulation method, replacement fluid, plasma exchange, blood flow rate, fluid balance, test indicators, and others) and checklist (involving 5 items of preparation prior to operation, preparation of pipeline, operation process, treatment process, and termination of operation) were prepared according to the mature domestic practice [6, 7], studies of domestic scholars [8], and the related documents [9]. Given the multiple CRRT treatment parameters and modes, there would be errors in communication between doctors and nurses, doctors shifting, and operation preparation [3]. The checklist can be used to check patient information, examination prior to operation, treatment mode, pipeline preflushing, anticoagulation method, replacement fluid, plasma exchange, blood flow rate, fluid balance, and detection indicators, which the doctors and nurses should confirm to reduce the incidence of information transmission errors to "zero." The complicated CRRT treatment procedures, as well as their unskilled and irregular operations, can delay the treatment. The breakdown can be used to guide the whole operation process and enable the nurses of different levels, especially junior nurses, to operate in accordance with the standard and norms, and gradually complete the preparation prior to operation, pipeline preparation, operation, treatment, and termination to ensure that the nurses can efficiently complete the preparation prior to operation, thus avoiding omissions due to the complicated process and numerous steps.

4.3. Significance of the Preparation of Breakdown and Checklist for Continuous Renal Replacement Therapy (CRRT). CRRT, with professional theory and skills and high operational risks, has proposed higher requirements for the overall quality of nurses; however, in the application of CRRT technology, nursing is the key to successful treatment [19]. Firstly, the breakdown and checklist can realize the homogeneous management of the whole process from the doctor's advice to the end of treatment, examine and monitor the nurse operation procedures, and guide the junior nurses. The incidence of adverse events has been reduced from 9.1% to 1.4% ($X^2 = 4.955$, $P = 0.026$). Secondly, the checklist can improve the work efficiency, and the breakdown can make the doctor's advice clearer, thus effectively avoiding time delays due to doctor's advice, while the checklist can ensure the preparation of items at one time and the orderly advancement of the treatment process, thus avoiding the waste of time due to omissions in the complicated process. In terms of handover, the breakdown and checklist should be used to show the entire process to the

Table 2: Results of the second round of consultation.

Indicators		Value of importance	Coefficient of variation	Full-score rate (%)
Patient information		5.00 ± 0.00	0.000	100
	Basic information	5.00 ± 0.00	0.000	100
	Diagnosis	5.00 ± 0.00	0.000	100
Evaluation prior to operation		4.33 ± 0.62	0.142	66.67
	CBP blood pathway	4.73 ± 0.59	0.125	80.00
	Coagulation indicators prior to operation	4.93 ± 0.26	0.052	87.77
Treatment mode		4.87 ± 0.35	0.072	80.00
	Mode selection	4.67 ± 0.49	0.105	66.67
	Filter selection	4.60 ± 0.63	0.137	66.67
Pipeline preflushing		4.47 ± 0.64	0.143	53.54
	Selection of preflush	4.40 ± 0.83	0.188	60.00
	Preparation of preflush	4.53 ± 0.74	0.164	66.67
Anticoagulation method		4.47 ± 0.74	0.166	60.00
	Anticoagulation with heparin	4.80 ± 0.41	0.086	80.00
	Anticoagulation with 4% citric acid	4.87 ± 0.35	0.072	86.67
Replacement fluid		4.27 ± 0.59	0.139	33.68
	Rate of front replacement fluid	4.87 ± 0.35	0.072	60.00
	Rate of rear replacement fluid	4.80 ± 0.41	0.086	80.00
	Rate of dialysate	4.00 ± 0.92	0.231	40.00
Plasma exchange		4.40 ± 0.74	0.167	40.00
	Plasma separation rate	4.87 ± 0.35	0.072	86.67
Blood flow rate		4.53 ± 0.64	0.141	60.00
	Initial blood flow rate	4.33 ± 0.72	0.167	40.00
	Target blood flow rate	4.27 ± 0.80	0.187	40.00
Fluid balance		4.33 ± 0.90	0.208	60.00
	The set ultrafiltration volume	4.87 ± 0.35	0.072	86.67
	Target dehydration volume	5.00 ± 0.00	0.000	100
Detection indicators		4.60 ± 0.51	0.110	60.00
	APTT-INR	4.13 ± 0.83	0.202	40.00
	Arterial blood gas analysis	4.20 ± 0.68	0.161	40.00
Others		4.93 ± 0.26	0.052	90.00
	5% sodium bicarbonate	4.73 ± 0.46	0.097	86.67
	10% potassium chloride	4.87 ± 0.35	0.072	90.00
	5% $CaCl_2$	4.87 ± 0.35	0.072	90.00
	10% sodium chloride	4.67 ± 0.62	0.132	86.67
Preparation prior to operation		4.20 ± 0.41	0.099	40.00
	Checking of doctor's advice	5.00 ± 0.00	0.000	100
	Patient preparation	4.67 ± 0.49	0.105	66.67
	Preparation of materials	4.60 ± 0.63	0.137	66.67
	Preparation of drugs	4.80 ± 0.41	0.086	80.00
	Other preparations	4.47 ± 0.74	0.166	60.00
	Evaluation of hemofiltration tube	4.80 ± 0.41	0.086	80.00
Pipeline preparation		4.73 ± 0.59	0.125	80.00
	Checking tight type of the AVF tube	4.93 ± 0.26	0.052	90.0
	Installing the pipeline according to the showed order	4.27 ± 0.96	0.227	30.00
	Checking the four pressure monitoring sensors and all clamps	4.60 ± 0.51	0.110	60.00
	Setting the preflushing volume and the related parameters	5.00 ± 0.00	0.000	100
	Adjusting the fluid level of the arteriovenous pot and removing the air bubbles from the filter	4.47 ± 0.64	0.143	60.00
	In the case of preflushing outside the membrane, check the direction of the filter, and reverse it if necessary	4.84 ± 0.35	0.072	86.67
Operation process		4.48 ± 0.57	0.133	86.67
	Checking the quality of preflushing, and making sure that it has been completed	4.41 ± 0.38	0.090	60.00
	Checking the smoothness of the hemofiltration tube	4.64 ± 0.52	0.113	90.00

Table 2: Continued.

	Indicators	Value of importance	Coefficient of variation	Full-score rate (%)
	Pressing the button "Stop" before introducing the blood to make sure that the pump is stopped and the patient connection interface is displayed	4.04 ± 0.74	0.184	40.00
	Observing the hemodynamic changes before and during the connection	4.14 ± 0.58	0.147	60.00
	Adjusting the replacement dialysis volume, blood flow rate, ultrafiltration volume, and other parameters	5.00 ± 0.00	0.000	100
	Properly fixing the hemofiltration tube	4.83 ± 0.31	0.066	60.00
Treatment process		4.12 ± 0.35	0.082	86.67
	Observing the changes in heart rate, blood pressure, and hemodynamic stability of each patient	4.23 ± 0.27	0.064	90.00
	Checking whether there are bleeding spots on the skin and mucosa and evaluating the bleeding and coagulation of the patients	4.37 ± 0.32	0.072	90.00
	Paying attention to the evaluation of the dehydration amount, urine volume, and water intake	4.21 ± 0.51	0.124	80.00
	Paying attention to the changes in various assay values	4.14 ± 0.35	0.086	86.67
	Evaluating patients' tolerance and whether sedation or restraint is required	4.45 ± 0.32	0.072	60.00
	Dealing with various alarms in time and paying attention to the changes of various parameters	5.00 ± 0.00	0.000	100
	Paying attention to the conditions of the skin to prevent pressure sores	4.12 ± 0.43	0.100	60.00
	Paying attention to the conditions of edema of the lower extremity to prevent thrombus of lower extremity veins	4.30 ± 0.30	0.072	86.67
	Assisting patients in proper bed movement to prevent thrombus of lower extremity veins	3.85 ± 0.71	0.180	40.00
Termination		4.55 ± 0.54	0.126	60.00
	Indications after termination	4.81 ± 0.24	0.050	80.00
	Doctor's advice after termination	5.00 ± 0.00	0.00	100
	Observation of the changes in heart rate and blood pressure of the patient	4.84 ± 0.11	0.020	90.00
	Prompt reminding of adjusting the amount of the pumped insulin and antibiotics	4.31 ± 0.32	0.126	40.00
	Final treatment	4.51 ± 0.53	0.070	60.00

successor to improve the efficiency and save handover time. Finally, the breakdown and checklist can improve the satisfaction of doctors and nurses, further clarify their responsibilities, and improve the effectiveness of communication between doctors and nurses [2]. Meanwhile, they can also help doctors and nurses to comprehensively understand the conditions of patients and the setting and adjustment of parameters during treatment. Moreover, it can improve the tacit understanding and truly reflect the treatment process of the integration of healthcare. Since their application, the satisfaction of medical care has been increased from 87% to 97.8% ($X^2 = 7.263$, $P = 0.026$).

5. Conclusion

This study constructs a CRRT nursing management plan; that is, a table, including 16 main indicators and 56 secondary indicators, and the indicators have good internal quality. Through clinical exploration, it has provided scientific basis for the nursing management of CRRT patients and has improved the job satisfaction of medical staff.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] X. H. Qiu and H. B. Qiu, "Progress in the application of CRRT in patients with serious infection," *Chinese Journal of Emergency Medicine*, vol. 20, no. 7, pp. 774–776, 2011.

[2] D. Y. Li, J. J. Wang, X. Li et al., "Design and application of continuous renal replacement therapy checklist for ICU patients," *Chinese Nursing Management*, vol. 19, no. 8, pp. 1180–1184, 2019.

[3] L. L. Kong, E. H. Chen, and Y. L. Qiu, "Design and application of nursing checklist for continuous renal replacement therapy in ICU patients," *Chinese Journal of Nursing*, vol. 52, no. 5, pp. 558–560, 2017.

[4] T. Liyanage, T. Ninomiya, V. Jha et al., "Worldwide access to treatment for end-stage kidney disease: a systematic review," *The Lancet*, vol. 385, no. 9981, pp. 1975–1982, 2015.
[5] J. M. Spector, P. Agrawal, B. Kodkany et al., "Improving quality of care for maternal and newborn health: prospective pilot study of the WHO safe childbirth checklist program," *PLoS One*, vol. 7, no. 5, Article ID e35151, 2012.
[6] Ministry of Health, *Standard Operating Proceduse of Blood Purification Center*, Ministry of Health, Colombo, Sri Lanka, 2010.
[7] Y. Zou, H. Wu, X. Guo et al., "MK-FSVM-SVDD: a multiple kernel-based fuzzy SVM model for predicting DNA-binding proteins via support vector data description," *Current Bioinformatics*, vol. 16, no. 2, pp. 274–283, 2021.
[8] W. Tang, S. Wan, Z. Yang, A. E. Teschendorff, Q. Zou, and C. Sahinalp, "Tumor origin detection with tissue-specific miRNA and DNA methylation markers," *Bioinformatics*, vol. 34, no. 3, pp. 398–406, 2018.
[9] Y. Wang, C. Ye, and Q. Jin, "Vascular pathway working group of Chinese hospital association blood purification center branch. Chinese blood dialysis system expert consensus (the first edition)," *Chinese Journal of Blood Purification*, vol. 13, no. 8, pp. 549–558, 2014.
[10] H. Zhu and H. Wang, "Effect of certain quinones on adenosine triphosphate level in human bladder cancer cells," *Indian Journal of Pharmaceutical Sciences*, vol. 82, pp. 1–6, 2020.
[11] X. Wang and Q. Yuan, "Evaluation of cognitive behaviour combined with biofeedback therapy based on the fusion of normed space and banach space on the emotional state of patients with coronary artery bypass grafting," *Indian Journal of Pharmaceutical Sciences*, vol. 82, pp. 7–13, 2020.
[12] Y. Liu, A. Li, G. Xie, G. Liu, and X. Hei, "Computational methods and online resources for identification of piRNA-Related molecules," *Interdisciplinary Sciences: Computational Life Sciences*, vol. 13, no. 2, pp. 176–191, 2021.
[13] L. Chen and X. Xu, "Effect evaluation of the long-term care insurance (LTCI) system on the health care of the elderly: a review," *Journal of Multidisciplinary Healthcare*, vol. 13, pp. 863–875, 2020.
[14] L. N. Chen and L. H. Zhang, "Investigation on construction of hospital innovation capacity evaluation index system," *Chinese Health Quality Management*, vol. 24, no. 2, pp. 117–120, 2017.
[15] C. Wang and T. Sun, "Construction evaluation index system for scientific and technological innovation ability of research hospitals," *Chinese Health Quality Management*, vol. 26, no. 3, pp. 130–133, 2019.
[16] X. Feng, J. Tian, B. Q. Wang et al., "Formulation of a nurse-led follow-up checklist for patients with laryngeal neoplasms," *Chinese Journal of Nursing*, vol. 53, no. 8, pp. 956–961, 2018.
[17] L. Wing, G. Ding, J. Xue, and Y.-W. Zhang, "PKN2 regulates the survival of pc12 cells by activating the AKT/mTOR pathway," *Indian Journal of Pharmaceutical Sciences*, vol. 82, p. 8, 2020.
[18] Z. Yun, Z. Hong, and Z. Dengchuan, "Risk factor analysis of pan-drug resistant acinetobacter baumannii-induced ventilator-associated pneumonia in ICU," *Indian Journal of Pharmaceutical Sciences*, vol. 82, pp. 8–11, 2020.
[19] S. D. Fei, J. F. Jin, H. Y. Wang, F. Ceng, Y. H. Xu, and J. F. CHen, "The related factors of unplanned interruption during continuous renal replacement therapy," *Chinese Journal of Nursing*, vol. 50, no. 1, pp. 57–61, 2015.