

Assessing a novel critical care ultrasonography training program for intensive care unit nurses in China

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Critical care ultrasonography (CCUS) is essential in the evaluation of shock, respiratory failure, and to guide central venous access.^[1] Nurses also use ultrasound for nursing practice such as thrombosis screening, ultrasound-guided vascular puncture, feeding tube placement, and lung physical therapy.^[2] CCUS strengths are lack of radiation, portability, and low costs. Therefore, CCUS has considerable clinical use in critical care. However, the acquisition of ultrasound images is the basis of accurate evaluation, and the accuracy of ultrasound is related to operator skill level. Additionally, the application of CCUS in nursing care depends on nurses' knowledge, and training. Although many clinical studies have been conducted on CCUS, there is little evidence on ultrasound training programs for intensive care unit (ICU) nurses.^[3] In this study, we designed and implemented a novel CCUS training program for ICU nurses. Our objective was to evaluate the effect of a short didactic training session on trainees' CCUS knowledge and skills.

This was a multicenter prospective study conducted in 15 regions across China from March 2016 to December 2020. ICU nurses with no previous ultrasound training were enrolled. All trainees underwent a 2-day CCUS training conducted by the Critical Care Ultrasound Study Group (CCUSG). The CCUS training for nurses was designed by the CCUSG and based on a literature review and clinical practice. The course program comprises 7 h of didactic lectures, 5 h of supervised hands-on practice on healthy volunteers, and a 3-h examination. The Supplementary file, <http://links.lww.com/CM9/A968> provides the CCUS training course schedule. The trainers were all accredited by the World Interactive Network Focused on Critical

Ultrasound and had 5 or more years of experience in CCUS practice. The effect of the program on ultrasound knowledge was evaluated using a theory examination, operational examination, and 2-month post-training evaluation. Trainees who completed the three tests and achieved a total score of 60 or more were considered qualified and awarded a CCUSG qualification certificate. The ethics committee of Peking Union Medical College Hospital approved the study (No.ZS-2140).

Statistical Product and Service Solutions 22.0 software (IBM Corp, Armonk, NY, USA) was used for data analysis. Descriptive statistics (frequency, percentage, mean, standard deviation) were used to describe participant demographic and background characteristics. Mann-Whitney *U* test (for non-parametric variables) and χ^2 test were used to compare the two groups' characteristics. All analyzes were performed using two-sided tests, and a *P* value <0.05 was considered statistically significant. Logistic regression analysis was performed with qualifying examination pass as the dependent factor, which was significant (*P* < 0.20) in a univariate analysis.

Thirty-four CCUS training programs were conducted and 1535 trainees attended the training over 5 years. A total of 506 trainees were excluded: 76 did not complete the theory examination, 12 did not complete the operational examination, 394 did not complete the post-training examination, 14 had to repeat the examination, and ten were nursing students. Finally, 1029 trainees were enrolled in the study. Of these, 867 (84.26%) passed the examination and were awarded a CCUSG qualification certificate. Table 1 shows that the scores were higher in the qualified group than those

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Table 1: Characteristics of the trainees enrolled in the study.

Characteristics	Trainees			Univariate analysis		Multivariate analysis	
	Overall (n = 1029)	Qualified (n = 867)	Non-qualified (n = 162)	Statistics	P	OR (95% CI)	P
Age (years)	32 (29, 36)	32 (29, 36)	32 (30, 36)	0.343 [†]	0.732		
Gender				5.112 [*]	0.025	0.587 (0.358–0.962)	0.035
Male	207 (20.1)	185 (21.3)	22 (13.6)				
Female	822 (79.9)	682 (78.7)	140 (86.4)				
Professional title				0.888 [*]	0.642		
Junior nurse	510 (49.6)	435 (50.2)	75 (46.3)				
Supervisor nurse	449 (43.6)	373 (43.0)	76 (46.9)				
Associate senior nurse and above	70 (6.8)	59 (6.8)	11 (6.8)				
Education degree				4.998 [*]	0.082	1.694 (1.055–2.720)	0.029
College degree	96 (9.3)	74 (8.5)	22 (13.6)				
Bachelor degree	892 (86.7)	756 (87.2)	136 (84.0)				
Postgraduate degree	41 (4.0)	37 (4.3)	4 (2.5)				
Hospital levels				13.819 [*]	0.001	1.738 (0.994–3.040)	0.052
Tertiary hospital	941 (91.4)	805 (92.8)	136 (84.0)				
The secondary hospitals	88 (8.6)	62 (7.2)	26 (16.0)				
Types of ICU				7.919 [*]	0.006	1.459 (0.999–2.131)	0.051
Genera ICU	730 (70.9)	630 (72.7)	100 (61.7)				
Special ICU	299 (29.1)	237 (27.3)	62 (38.3)				
ICU beds	20 (15, 30)	22 (15, 30)	18 (12.0, 22.3)	5.647 [†]	<0.001	1.042 (1.024–1.062)	<0.001
Years of experience in critical care	8 (5, 12)	8 (5, 12)	8 (5.8, 12.0)	0.466 [†]	0.641		
Whether equipped with ultrasound machine				3.577 [*]	0.080	1.054 (0.556–2.000)	0.872
Yes	962 (93.5)	816 (94.1)	146 (90.1)				
No	67 (6.5)	51 (5.9)	16 (9.9)				
Whether attended relevant training				2.067 [*]	0.160	1.433 (1.007–2.039)	0.046
Yes	630 (61.2)	539 (62.2)	91 (56.2)				
No	399 (38.8)	328 (39.1)	71 (43.8)				
The total score of skills exam	72 (63, 78)	74 (68, 80)	50 (46, 55)	20.235 [†]	<0.001		
Theory exam	24 (22, 26)	24 (22, 26)	23 (20, 25)	5.409 [†]	<0.001		
Operation exam	16 (14, 18)	16 (15, 18)	15 (12, 17)	6.103 [†]	<0.001		
Post-training exam	32 (25, 38)	33 (28, 39)	10 (8, 16)	19.599 [†]	<0.001		

Data are presented as n (%) or median (interquartile range). * χ^2 values. [†] Z values. CI: Confidence interval; ICU: Intensive care unit.

in the non-qualified group. The multivariate logistic regression analysis showed that being male (odds ratio [OR]: 0.587, 95% confidence interval [CI], 0.358–0.962, $P = 0.035$), education degree (OR: 1.694, 95% CI: 1.005–2.720, $P = 0.029$), ICU beds (OR: 1.042, 95% CI: 1.024–1.062, $P < 0.001$), and relevant training experience (OR: 1.433, 95% CI: 1.007–2.039, $P = 0.046$) were independent predictors of qualification in the CCUS training program.

This study aimed to investigate the effect of a novel ultrasound training program on the knowledge and skills of nurses in China. Furthermore, we divided trainees into two groups according to qualification status. This prospective observational study that addresses a research gap by evaluating a CCUS training program for ICU nurses. Our findings confirmed that a 2-day CCUS training session for ICU nurses can improve knowledge and CCUS skills.

Our CCUS nurse training program was based on previous ultrasound training^[4] and has several key advantages.

First, the training was practical and novel. The program focused on the application of CCUS in critical care nursing. The appropriate use of qualitative and quantitative ultrasound evaluation can guide nursing practice and improve the quality and efficiency of critical care.^[5] Second, the teaching styles were diverse, including case study-based learning, problem-based learning, hands-on training, and team-based learning. These various methods allowed nurses to quickly understand ultrasound theory and work together in groups.^[4] Third, the training evaluation promoted the continuous improvement of training. We conducted knowledge assessment, skills assessment, and 2-month post-course evaluation. The CCUS training program facilitated clinical decision-making in the ICU.

This study has several limitations. The study took 5 years to complete and contained complete case data; therefore, the results are highly reliable. However, this was a prospective observational study and several factors may

have affected the results during the different study phases. Additionally, we examined trainee performance only after training, not before training. All participants were nurses with no previous systematic CCUS training. Therefore, a multicenter large-sample cohort study is needed to confirm the clinical feasibility of CCUS training for nurses.

These findings shed new light on ultrasound training programs for nurses. We found that a 2-day CCUS training session for ICU nurses improved knowledge and CCUS skills. A short didactic presentation may be useful to encourage the use of bedside ultrasound in ICUs. Further research is needed to improve point-of-care ultrasound competence.

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Conflicts of interest

None.

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