A Nationwide Three-Month Education Program for Venoarterial Extracorporeal Membrane Oxygenation

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Extracorporeal membrane oxygenation (ECMO) is a rescue therapy in patients with cardiopulmonary emergencies (1, 2). Although the use of ECMO is gradually increasing, ECMO is still a very costly and invasive treatment. ECMO education programs may expand the availability of this treatment to meet growing needs (3). Fuwai Hospital is a national center for cardiovascular disease in China, and it has provided ECMO support since 2004 (4, 5). In 2019, Fuwai hospital launched a three-month education program for venoarterial (V-A) ECMO that recruited participants from all over the nation. The program was composed of didactic courses, water-drill courses, high-fidelity simulation, and clinical training. By June 2022, 10 sessions had been held. This study aimed to introduce the three-month education program for V-A ECMO and to evaluate the program by assessing the participants' feedback.

METHODS

The observational study introduced and evaluated a nationwide three-month education program for V-A ECMO between May 2019 and June 2022 at Fuwai Hospital. The study was approved by the institutional review board of Fuwai Hospital on August 17, 2022 (approval no. 2022-1809). The survey was

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distributed to participants after the institutional review board approved the study.

The program was funded by the tuition paid by participants. Each cycle of the program recruited five to eight participants. The program was composed of five sections: *1*) didactic courses; *2*) water-drill courses; *3*) high-fidelity simulation training; *4*) clinical training; and *5*) case report presentation (*see* data supplement Document 1).

Didactic sessions totaled 12 hours, 1 hour per week. Each section was 30 minutes and was held twice a week (*see* data supplement Document 2).

The water-drill courses introduced the equipment used in ECMO and the structure of the circuit. The preceptors showed how to assemble and prime the circuit, and then the participants practiced on a closed-loop ECMO circuit. Four discussion sessions were held on troubleshooting in priming different ECMO circuits.

In high-fidelity simulation training, 10 scenarios were designed in one case (*see* data supplement Document 3). Scenarios were then followed by debriefings. The manikin used in simulations was developed by our team. A Rotaflow (Getinge) or Bioconsole 560 (Medtronic) ECMO machine was used in simulation training. A Califia patient simulator (Biomed Simulation Inc.) was used to simulate patient parameters.

The clinical training included rotations in three departments. In the department of cardiopulmonary bypass (CPB), the participants learned the physiology of circulation and CPB (2 wk). In the department of anesthesiology, they learned the transesophageal echocardiography (2 wk). In intensive care units, they learned how to prepare for ECMO implementation, prime the ECMO circuits, and manage patients receiving ECMO at the bedside (4 wk).

The case report presentation was held in the last week of the program. The participants summarized a case of a patient they encountered during the program, and they presented the case to the preceptors.

A survey that evaluated the effect of the program was administered on August 20, 2022, via a web-based survey through the Wenjuanxing platform (www.wjx.cn) sent by WeChat (Tencent) group talk (*see* data supplement Document 4). The survey was open for 10 days, and all responses were collected anonymously.

The 5-point Likert scale was used to assess the participants' attitudes toward the program.

RESULTS

Sixty-one participants participated in 10 sessions of the program. All participants completed the program and the survey.

Participant Characteristics

Participants were physicians and nurses from 21 provinces in China (Table 1). They were from the departments of critical care, emergency, anesthesiology, cardiac surgery, cardiology, and the general intensive care unit. Fifty-three (86.9%) of them were from public general hospitals, and 54 (88.5%) were from tier 3A hospitals. Thirty-seven participants had a graduate degree, and 23 (37.7%) participants were associate professors or professors. Most of them reported that they had >5 years of clinical experience. However, 31 (50.8%) claimed that they cared for fewer than 10 patients receiving ECMO in the past year.

Participant Feedback through the Survey

More than 50 participants totally agreed that the didactic courses were effective (Figure 1). However, only 44 (72.1%)

Table 1. Participant characteristics

Variable	Overall Cohort ($n = 61$)
Age, yr	
<20	1 (1.6)
20–40	44 (72.1)
>40	16 (26.2)
Profession	
Physician	47 (77.0)
Nurse	14 (23.0)
Department	
Critical care	34 (55.7)
Emergency	7 (11.5)
Anesthesiology	2 (3.3)
Cardiac surgery	5 (8.2)
Cardiology	10 (16.4)
General ICU	3 (4.9)
Category of the hospital	
Public general	53 (86.9)
Public special	7 (11.5)
Private general	1 (1.6)
From tier 3A hospital	
Yes	54 (88.5)
No	7 (11.5)
Education background	
Junior college	4 (6.6)
Senior college	20 (32.8)
Graduate	37 (60.7)
Ranking	
Resident	8 (13.1)
Attending	30 (49.2)
Associate professor	17 (27.9)
Professor	6 (9.8)

Table 1. *Continued.*

Variable	Overall Cohort (*n* = 61)
Years of clinical experience	
<3	1 (1.6)
3–5	5 (8.2)
5–10	23 (37.7)
>10	32 (52.5)
Patients receiving ECMO cared for in the past year	
0–10	31 (50.8)
11–20	12 (19.7)
21–30	6 (9.8)
30–40	1 (1.6)
>40	11 (18.0)
Year of participation	
2019	21 (34.4)
2020	17 (27.9)
2021	20 (32.8)
2022	3 (4.9)

Definition of abbreviations: ECMO = venoarterial extracorporeal membrane oxygenation; ICU = intensive care unit; tier 3A hospital = comprehensive, referral, general hospitals at the city, provincial, or national level with a bed capacity exceeding 500.
Data are presented as *n* (%).

totally agreed that their understanding of extracorporeal cardiopulmonary resuscitation was improved. Forty-one (67.2%) totally agreed that the simulation scenario was high fidelity, and 50 (82%) totally agreed that the scenario was common in clinical practice. However, some participants claimed that they did not have sufficient opportunities for clinical practice. They all agreed that the program had improved their skills in operating the devices, changed some of their clinical habits, and improved their confidence when caring for the patients receiving ECMO. Sixty (98.4%) agreed that their patients' prognosis was improved.

DISCUSSION

ECMO is currently outside the scope of conventional training for physicians and nurses. ECMO is of low frequency but complex, for which patient volume in most hospitals is insufficient to train clinicians. Therefore, training away from the bedside is commonly used to train new ECMO specialists.

The study evaluated the formal extended ECMO education program that contained clinical training. Our program recruited multidisciplinary participants across the country. Most education programs were 1–3 days (6), and some were designed to

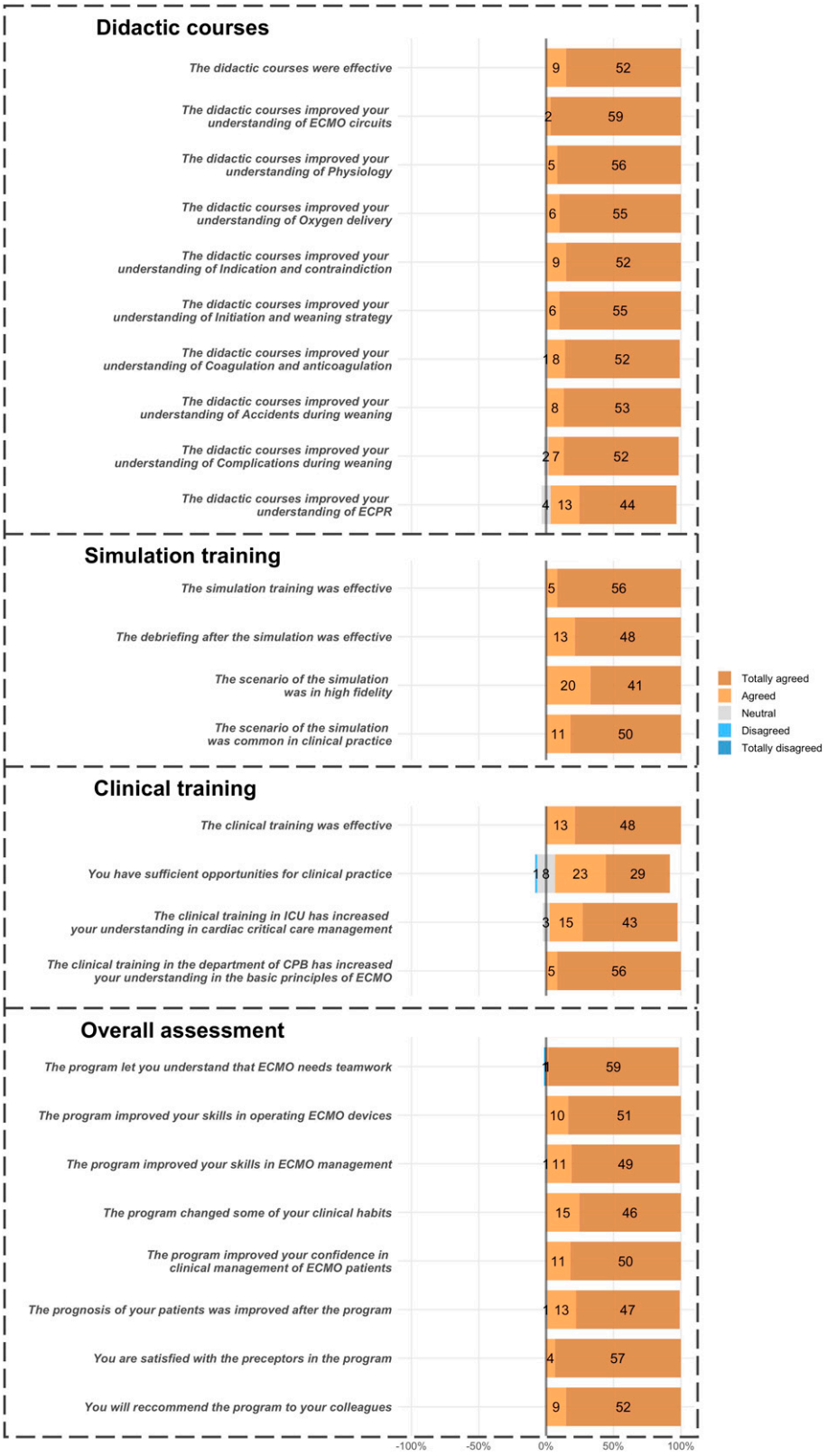

Figure 1. Participant feedback about the program. CPB = cardiopulmonary bypass; ECMO = extracorporeal membrane oxygenation; ECPR = extracorporeal cardiopulmonary resuscitation; ICU = intensive care unit.

train the staff in the centers' own ECMO team (7). It is also noteworthy that our program has clinical training, which provides bedside education for participants. Multidisciplinary rotations allowed participants to have a more comprehensive understanding of ECMO. Eight weeks of clinical training guaranteed participants chances for bedside learning of patients receiving ECMO. If the participants receive only a few days of clinical training, there may be no patients receiving ECMO during the training period.

Participants were less satisfied with clinical training. Some participants claimed that they did not have sufficient opportunities for clinical practice. On one hand, participants' involvement in bedside training was limited by patients' status, as patients supported with ECMO were generally critically ill. On the other hand, preceptors lack experience in clinical training design, which needs to be further improved. In further clinical training, we will introduce a three-step training including discussion of previous similar cases, bedside teaching, and a question-and-answer session.

Conclusions

Development of a nationwide three-month education program for V-A ECMO was feasible and was well received by the learners. The program can be further improved by providing more opportunities for direct patient care under the supervision of the instructors and by faculty development in bedside teaching.

Author disclosures are available with the text of this article at www.atsjournals.org.

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