Original Article

Specifying the Objectives and Techniques of a Competency-based Training Program to Improve Post-anesthesia Care Unit Nurse Performance: A Delphi Study

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Abstract

Background: Clinical competence in detecting complications is crucial for anesthesia nurses working in the Post-Anesthesia Care Unit (PACU). This study utilized the Delphi method to identify essential core competency-based learning objectives for this specialized nursing role. The research also aimed to develop a practical and implementable training program, encompassing appropriate pedagogical approaches and defining the required duration of training. **Materials and Methods:** This qualitative study employed a two-round Delphi method, with invitations extended to 50 faculty members and clinical anesthesia instructors in Iran. During the first round, participants assessed the learning objectives using a 5-point Likert scale. Subsequent to the initial Delphi round and data analysis, all items reaching a median score of at least four, in conjunction with newly proposed objectives, were categorized and presented for re-evaluation. To ascertain suitable teaching methods and the necessary number of sessions, two multiple-choice questions were posed at the conclusion of each round. Descriptive statistics, including median, interquartile range, frequency, and percentages, were used for data analysis. **Results:** A total of 37 out of 50 panel members (74%) participated in both rounds of the Delphi study. Consensus was reached on 95 learning objectives. To achieve the learning objectives in each group, specific teaching methods were selected. The proposed number of sessions to achieve the objectives totaled 10 sessions, equivalent to 15 hours. **Conclusions:** A supplementary training program for PACU care was developed using the Delphi method to enhance the clinical competence of anesthesia nurses.

Keywords: *Delphi technique, education, post-anesthesia nursing, recovery room*

Introduction

The Post-Anesthesia Care Unit (PACU) was first established in the 18th century by Florence Nightingale and is now recognized as a critical care and recovery unit for patients undergoing general or regional anesthesia. Early recovery from anesthesia is a dynamic period during which vital systems recover from the effects of deep anesthesia and surgical trauma. During this period, patients are susceptible to pain, delirium, hypothermia, hypoxia, postoperative pulmonary complications, hypotension, bradycardia, myocardial infarction, cardiac arrest, and even death.[1,2] In addition to the aforementioned complications, other adverse events such as clinical deterioration, reintubation, prolonged hospital stay, disability, surgical complications, impaired nutrition, wound infection, and bleeding may occur, which can lead to permanent patient harm.[3,4] Since the goal of the care team in PACU is to gradually awaken patients and prevent sudden changes in hemodynamics, it can be concluded that continuous monitoring of patients in the PACU by anesthesia nurses can lead to early detection of complications and prompt initiation of treatment, reducing their severity. Globally, postoperative mortality is recognized as a leading cause of death, and it has been stated that most deaths related to surgery and anesthesia occur in the postoperative period.[5] According to a report by Ball *et al*. in 2018, the cause of postoperative deaths is inadequate nursing care and negligence in caring for patients.[6,7] Therefore, it is necessary for anesthesia nurses working in this unit to have clinical competence so that they can provide specialized care for patients.[4]

The ongoing education of anesthesia nurses is paramount for maintaining and improving

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their competence. However, a significant gap exists in international consensus regarding the specific educational requirements and professional roles of PACU nurses.[8] Therefore, it can be concluded that a coherent education in this area can have a significant impact on the quality and effectiveness of services provided to the patients.[9-11] Despite the emphasis on the necessity of conducting specialized PACU training courses to prepare and qualify anesthesia nurses in providing postoperative care, a few studies have addressed this topic. For example, Hvidberg *et al.* [2021][4] study identified 180 learning objectives without specifying teaching methods or session numbers. In fact, these studies have merely outlined the important points that should be considered in acquiring the competence of experts and their training, without designing and offering any systematic and comprehensive training course that can be implemented in this field. Within Iran, a significant number of anesthesia nurses are involved in the care of patients in the PACU without having received specific training relevant to this specialized area. Moreover, there is a lack of both academic and practical consensus regarding patient care standards in the PACU. Consequently, no dedicated training program or protocol is in place for newly employed anesthesia nurses. Therefore, this study aimed to identify the essential core competency-based learning objectives required for anesthesia nurses entering the PACU field through the Delphi technique. Subsequently, it developed a practical and implementable training program that outlined appropriate educational methodologies and the necessary duration for effective implementation. The findings of this study can then inform the training and enhancement of clinical competence among PACU anesthesia nurses, with the ultimate goal of improving patient outcomes.

Materials and Methods

This qualitative study employed a two-round Delphi method and was conducted in Iran in 2024. In Iran, all personnel working in PACU hold a Bachelor's degree in nursing or anesthesia nursing. Upon graduation, nurses work in PACU based solely on their Bachelor's degree and the needs of medical centers, providing care to postoperative patients. There is no official requirement to complete a specialized training course and obtain a certificate. In this study, the Delphi method was used to design a supplementary training program for PACU care, which includes prioritizing learning objectives and determining appropriate teaching methods and the necessary duration for implementation. The Delphi method is a valid scientific method used to extract and refine group judgments and solve complex problems through expert consensus. This process involves sending a questionnaire to a group of experts and specialists in a field, allowing geographically dispersed but knowledgeable individuals to participate in group consultation.[12] The difference between this method and other consensus-building methods is that in this method, group members participate anonymously and the process can be repeated several rounds if necessary. The Delphi method lacks explicit and definitive guidelines for selecting the number of experts, and most studies typically involve fewer than 50 participants, often ranging between 15 and 20.[13] In this study, ten individuals were initially selected from among the faculty and clinical anesthesia instructors of all medical universities in Iran who had at least 5 years of teaching or clinical experience in PACU using purposive sampling. Conversations with initial participants and the application of snowball sampling identified an additional 40 individuals for the first Delphi round, who were then invited to participate via telephone. All 50 invited experts expressed their willingness to participate in the study, and the Delphi questionnaire was subsequently sent to them.

The Delphi study was conducted in two rounds, both electronically and on paper. In the first phase, a comprehensive search was conducted in databases including PubMed, Google Scholar, and Scopus using keywords such as "post-anesthesia care", "Delphi method", "PACU education", "anesthesia nursing student education", and "consensus methods" (search for resources was limited to 2015–2024 to ensure up-to-date competencies). Additional article selection criteria included relevance to the clinical competencies of nurse anesthetists in clinical settings, a clear research methodology, and publication in English in reputable journals and databases. The research team then consulted relevant texts on essential core competency-based learning objectives for PACU anesthesia nurses, removed duplicates, and extracted a list of 111 items. These items were then formatted into a questionnaire using a 5-point Likert scale (1 = not important, 2 = slightly important, 3 = important, 4 = very important, 5 = mandatory) for each question. At the end of the questionnaire, a section was dedicated for participants to suggest additional objectives not included in the questionnaire. After the questionnaire was approved by three members of the anesthesia faculty at Ahvaz Jundishapur University of Medical Sciences (AJUMS), Iran, the first round of the Delphi began. Each of the 50 participants was asked to rate each of the primary learning objectives on a 5-point Likert scale and to suggest any additional objectives not included in the questionnaire in the designated space. Upon completion of the first round of the Delphi and analysis of the results, all items with a minimum median score of 4 and a q3-q1<3, as well as additional learning objectives suggested by participants, were categorized into four groups based on their educational nature (1, cognitive knowledge and theoretical content; 2, familiarity with PACU equipment and advanced life support; 3, performing care procedures and evaluating various patient-connected equipment; 4, documentation and patient communication) and reformatted into a questionnaire with a 5-point Likert scale for each question. To determine the appropriate teaching method and the number of sessions required to achieve each group of learning objectives, two questions were asked at the end of each group of learning objectives: 1(Which teaching method do you suggest to achieve the learning objectives in group...? and 2(How much time do you suggest to achieve the learning objectives in group...?

Following consultation with two medical education experts, each question provided multiple predefined options. These included various teaching methods, session numbers, and the required time to achieve each set of learning objectives, allowing participants to select their preferred choice. Then the second round of Delphi began, and the Delphi panel members were invited to complete the questionnaire and express their opinions. Questionnaires were saved in Microsoft Word 2019 and were provided to the panel members via email or in paper form, depending on how they could be accessed. Members who did not respond to the questionnaire in the first round of Delphi were excluded from the second round. However, if a questionnaire was partially completed, the data were included in the statistical analysis, and the participant was invited to participate in the second round of Delphi. In the first round, Delphi panel members were allowed to express their opinions on the learning objectives at the end of the questionnaire. In both rounds of Delphi, items that had a minimum median score of 4 and inter-quartile range (IQR) <3 were retained, and other items were removed. In both rounds of Delphi, at the beginning of the questionnaire, explanations were provided regarding the study purpose and method, completion of the questionnaire, anonymity of the participant, and confidentiality of the information. A 2-week deadline was set for completing the questionnaire in each Delphi round. Reminders were sent via email or text message after 10 days of no response. A 4-week interval separated the two rounds. [Figure 1].

In this study, after the completion of each Delphi round, the results were analyzed using SPSS software (IBM Corp, 2020, Version 27). The qualitative data generated in the first round of Delphi were analyzed using an inductive content analysis approach. In this way, all of the panel members' suggestions mentioned in the last box of the questionnaires were examined and included as learning objectives in the second round of the Delphi questionnaire. In both rounds of Delphi, the median and IQR were used to evaluate and prioritize learning objectives. In the second round of Delphi, descriptive statistical methods, including percentages and frequency tables, were used to determine the appropriate teaching method as well as the number of sessions and hours required for each set of learning objectives.

Ethical considerations

This study was approved by the Ethics Committee of AJUMS, Iran, (IR.AJUMS.RESEARCH.REC.1403.076, 1403/02/29). In both rounds of Delphi, written informed consent was taken from every participant. At the beginning of the questionnaire, explanations were provided regarding the study purpose and method, completion of the questionnaire, anonymity of the participant, the voluntary nature of participation, and confidentiality of the information (in this study, only one researcher who made a phone call to the participants was aware of their identity and other researchers and Delphi panel members were unaware of each other's identity and data analysis was also performed anonymously).

Results

Characteristics of Delphi panel members

The Delphi panel consisted of 25 faculty members from the anesthesiology and anesthesia nursing departments of medical universities and 25 clinical anesthesia instructors working in PACU, who were invited to participate in the study from medical centers and universities across the country. The faculty members and clinical instructors who participated in both rounds had an average clinical experience of 17.5 (range 5 to 30) years.

Delphi rounds

First round of Delphi

Of the 50 Delphi panel members, 47 responded to the questionnaire, and thus, the response rate in the first round of Delphi was 94%. Of these, 34 questionnaires were fully completed, while the remainder were incomplete. Based on the study design, the completed sections of the questionnaires were included in the data analysis. Of the 124 total learning objectives, 83 achieved a median equal to or greater than four or an IQR less than three (predefined consensus). An additional 13 learning objectives were suggested by participants, which were incorporated into the second round of the Delphi questionnaire for further consideration.

Second round of Delphi

In the second round, 37 of the 47 Delphi panel members invited (those who participated in the first round) returned completed questionnaires, representing a response rate of 78%. Of these, 33 were fully completed, with the remaining submissions being incomplete. The overall response rate for the entire Delphi study was 74% (37 out of the original 50 panel members). The analysis of the second round revealed that 95 of the 96 learning objectives met the predefined consensus criteria (median $\geq$ 4 and IQR < 3) [Table 1]. Items that did not reach consensus are detailed in Table 2.

To determine the appropriate teaching method as well as the number of sessions and hours required to achieve each set of learning objectives, a frequency table was generated separately for each question, and the option with the highest frequency was selected as the preferred option of the panel members [Table 3].

Of the 37 experts who completed the second-round questionnaires, 34 responded to questions regarding teaching methods and session numbers. For Groups 1, 2, 3, and 4, the selected teaching methods were lecture, simulation, movie playback and group discussion, and Case-Based Learning (CBL), respectively. The proposed training program comprises the following: Group 1: four 1.5-hour sessions; Group 2: two 1.5-hour sessions; Group 3: two 1.5-hour sessions; and Group 4: two 1.5-hour sessions, totaling 10 sessions (15 hours).

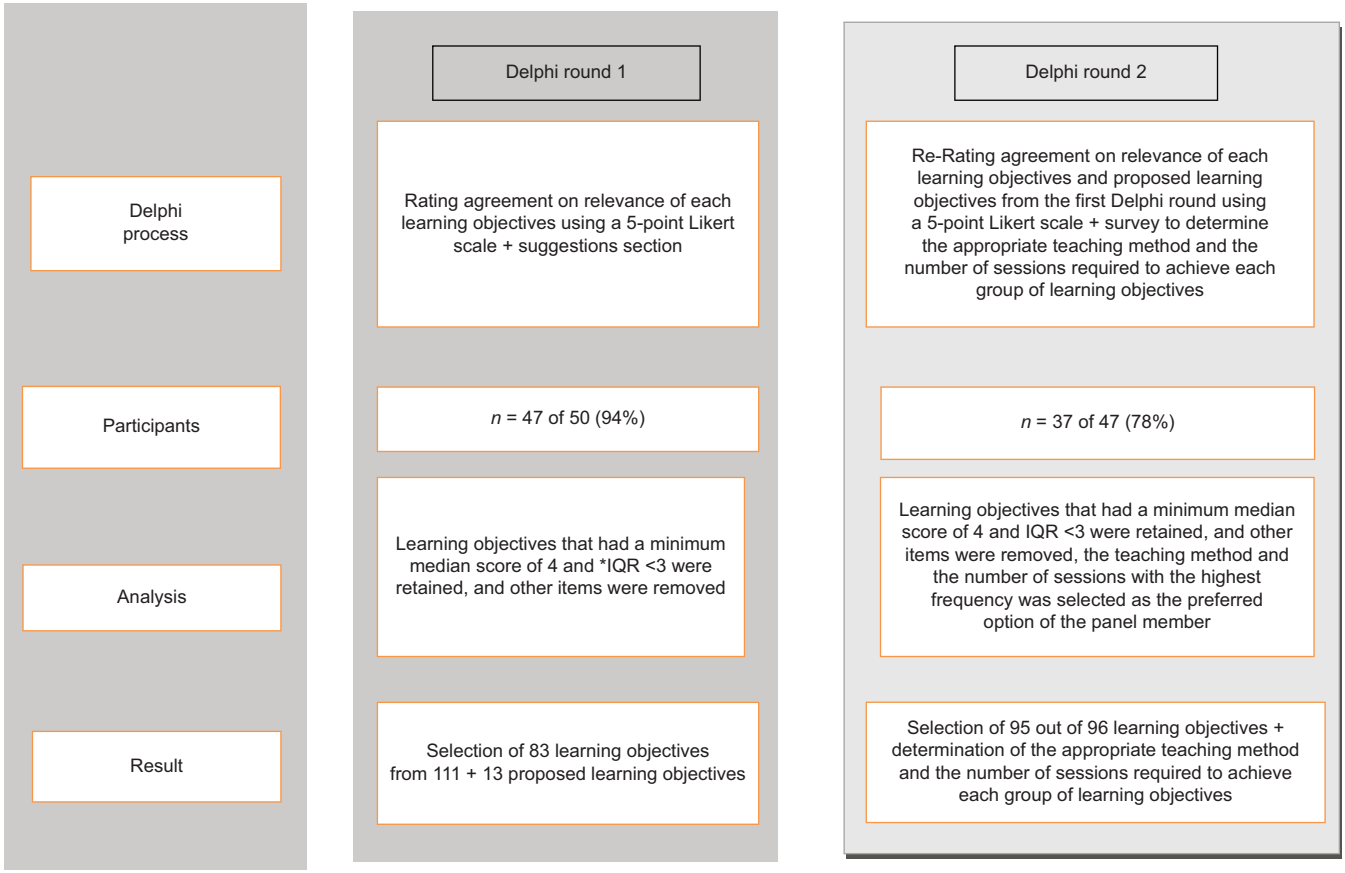

Figure 1: Flowchart of the Delphi process, Inter Quartile Range=Quartile$_3$-Quartile$_1$

Discussion

The incidence and severity of post-anesthesia complications vary widely across different countries due to factors such as the lack of knowledgeable and trained anesthesia nurses, differences in basic educational programs, and the absence of a specific supplementary training program for nurses.[14,15] Given the absence of a standardized training program for anesthesia nurses,[4] we decided to develop a supplementary training program for PACU nurses using the Delphi method to enhance their clinical competencies. To the best of our knowledge, this is the first supplementary training program designed to enhance the competencies of anesthesia nurses in the PACU based on a national consensus in Iran.

Ninety-five core competency-based learning objectives were categorized into four groups based on their educational nature, covering a wide range of knowledge and skills required for an anesthesia nurse working in the PACU. A common thread among the competencies was their focus on postoperative complications, which occur in approximately 24% of PACU patients. Common complications in the PACU include nausea and vomiting (9.8%), upper airway obstruction (6.9%), and hypotension (2.7%). Our study also identified key competencies and objectives, including understanding the assessment and management of nausea and vomiting, airway assessment and ventilation techniques, the causes and treatment of airway obstruction, methods of maintaining a patent airway, diagnosis and treatment of stridor, post-extubation risks (laryngospasm and bronchospasm), blood pressure disorders, and the most common causes and treatments of hypotension and hypertension. These were deemed crucial considerations in the development of our supplementary training program. Therefore, these competencies and learning objectives appear to align with the existing literature on PACU complications and challenges.[4]

of the 124 total learning objectives, 29 were eliminated by the Delphi panel members. The most significant eliminations included: how to insert a central venous catheter (CVC), how to administer intravenous nutrition, how to prepare equipment for dialysis catheter insertion, and how to prepare equipment for chest tube insertion. These procedures require specialized knowledge and skills typically possessed by anesthesiologists or Intensive Care Unit (ICU) nurses. In addition, two objectives—epidural anesthesia administration and the use/interpretation of train of four (TOF) equipment—were eliminated, likely due to their infrequent application in Iranian PACUs. This exclusion ensures the training program focuses on essential and commonly needed skills for PACU nurses. However,

Table 1: Findings from the second round of Delphi

	Median* (Q_3-Q_1)
Group One:	
Explain factors causing arrhythmias and myocardial ischemia	5 (5-4)
Assess blood pressure disorders	5 (5-4)
Explain the most common causes of hypertension and its treatment	5 (5-4)
Explain the most common causes of hypotension and its treatment	5 (5-4)
Assess types of shock (hypovolemic, cardiogenic, obstructive, anaphylactic, and neurogenic)	5 (5-4)
Assess vasovagal reactions	5 (5-4)
Administer inotropic drugs, such as epinephrine	4 (5-3)
Administer parasympatholytic drugs, such as atropine	5 (5-4)
Explain and administer vasopressors like norepinephrine and phenylephrine	4 (5-4)
Explain coagulation issues and causes of bleeding	4 (5-3)
Explain the principles of blood transfusion	5 (5-4)
Explain indications, contraindications, and complications of blood perfusion	5 (5-4)
Explain the principles of largevolume blood product perfusion	5 (5-4)
Calculate fluid therapy	5 (5-4)
Assess the adequacy of fluid therapy	5 (5-4)
Calculate hourly diuresis (diagnosing oliguria, etc.)	5 (5-3.50)
Explain indications, contraindications, and complications of fluid therapy	4 (5-4)
Explain indications, contraindications, and complications of glucoseinsulin and glucoseinsulinpotassium infusions	5 (5-4)
Evaluate and treat PostOperative Nausea and Vomiting (PONV)	5 (5-4)
Explain shivering and its treatment	5 (5-4)
Assess neuromuscular status	4 (4-3)
Explain delirium and its management	4 (4-3)
Explain indications and contraindications of anesthetic drugs used for sedation and analgesia	5 (5-4)
Evaluate the effects and side effects of anesthetic drugs used for sedation and analgesia	4 (5-4)
Explain the causes of delayed awakening	5 (5-4)
Explain recovery in outpatient surgeries	4 (5-3)
Prevent falls from the bed	5 (5-4)
Explain the causes and treatment of restlessness	4 (5-3.25)
Explain the causes and prevention of corneal abrasions	4 (5-3)
Calculate drugs (emergency trolley)	5 (5-4)
Assess pain of patients using appropriate pain assessment tools	4 (4.75-3)
Explain the timing and administration of medications (such as for asthma) in **PACU	4.50 (5-4)
Explain the antagonists for anesthetic and narcotic drugs	5 (5-4)
Apply Glasgow Coma Scale	4 (5-4)
Explain the causes and treatment of headache following spinal anesthesia	4 (5-3)
Explain postoperative risk factors in children	4 (5-4)
Explain postoperative considerations for patients with obstructive sleep apnea	4 (5-4)
Explain postoperative considerations for diabetic patients	4 (5-4)
Explain postoperative considerations after cesarean section	4 (5-4)
Explain postoperative considerations for mothers with preeclampsia and eclampsia	4 (5-4)
Assess Apgar in newborns	4 (5-3)
Describe the principles of infection prevention related to inserted tubes/catheters	4 (5-3)
Explain the importance of early mobilization in improving oxygenation and blood circulation	4 (5-3)
Explain the risks associated with inadequate postoperative pain management	4 (5-3)
Explain pain management in patients with acute pain	4 (5-3)
Explain the use of PatientControlled Analgesia (PCA)	4 (5-3)
Explain the pharmacodynamics and pharmacokinetics of analgesic drugs	4 (5-3)
Explain the pharmacodynamics and pharmacokinetics of antidotes	4 (5-4)
Assess airway and ventilation	5 (5-4)
Explain the methods of maintaining a patent Airway	5 (5-5)
Explain the causes and treatment of airway obstruction	5 (5-5)
Assess hypoxia	5 (5-4.50)

Contd...

Table 1: Contd...

	Median* Q_3-Q_1
Explain inhaled drugs and their side effects	4 (5-3)
Explain the risks associated with oxygen therapy	4 (5-4)
Explain the postextubation risks (such as laryngospasm and bronchospasm)	5 (5-5)
Manage pulmonary embolism	4 (5-4)
Diagnose stridor	5 (5-3)
Explain the treatment of stridor	4.50 (5-4)
Assess bleeding	4 (5-3)
Assess compartment syndrome	4 (5-3)
Assess positioningrelated complications	4 (5-3)
Explain the importance of monitoring fluid and food intake and recommended surgical restrictions	4 (5-3)
Explain the optimal positions in PACU	4 (5-3)
Assess discharge criteria (e.g., ability to eat and drink, having a responsible companion, minimum recovery time)	4 (5-3)
Explain the discharge criteria (Aldrete's scoring system)	5 (5-4)
Group Two	
Monitor and assess heart rate and blood oxygen saturation	5 (5-4)
Monitor and assess blood pressure	5 (5-4)
Monitor and assess blood glucose	5 (5-4)
Monitor and assess body temperature	5 (5-3.50)
Monitor and assess Arterial Blood Gases (ABG)	4 (5-3)
Use glucose meter equipment	4 (5-3)
Use electrocardiography equipment	5 (5-3.50)
Use heart rate and oxygen saturation monitoring equipment	5 (5-4)
Use temperature monitoring equipment	4 (5-3)
Explain the equipment required in PACU	5 (5-4)
Use continuous noninvasive arterial blood pressure monitoring devices	4 (5-4)
Use defibrillator during cardiopulmonary resuscitation	5 (5-4)
Perform Advanced life support	5 (5-5)
Use syringe pumps	5 (5-3)
Set up the ventilator	5 (5-3.50)
Use equipment for Continuous Positive Airway Pressure (CPAP)	4 (5-3)
Explain the types of oxygen masks for respiratory support in PACU	5 (5-4)
Explain the tpiece and its applications	5 (5-3.25)
Group Three:	
Perform suctioning of the throat and larynx	5 (5-4)
Insert urinary catheters in men and women	4 (5-3)
Insert and evaluate Nasogastric (NG) tube function	4 (5-3)
Assess function of peripheral lines	5 (5-4)
Assess function of surgical drains	4 (5-3)
Assess surgical dressings	4 (5-3)
Assess splints/casts	4 (5-3)
Perform tracheostomy care	4 (5-3.50)
Group Four:	
Perform report writing in PACU	4 (5-3)
Handover the patient from the operating room	5 (5-4)
Apply aseptic technique for procedures	5 (5-3)
Communicate with patients and their companions	4 (5-4)

*Inter Quartile Range=$Quartile_3$-$Quartile_1$. **Post Anesthesia Care unit

to address this, advanced training courses and optional educational modules can be developed in the future for nurses in facilities with a broader scope of practice.

Recognizing the potential for significant variation in the quality of Delphi studies,[16] we implemented the Delphi process in this research following established methodologies from related studies to ensure rigor. To mitigate the influence of regional and participant-specific factors on Delphi results,[2,4] our panel comprised interested anesthesiology faculty members and clinical instructors from diverse geographic locations within the country,

Table 2: Excluded learning objectives during two Delphi round

	Median* Q_3-Q_1
Insert Central Venous Catheter (CVC)	2 (3-2)
Explain the physiology and pathophysiology of the heart and blood vessels	3 (4-3)
Assess cardiac contraction, preload, afterload, and pump function related to peripheral resistance	3 (4-3)
Interpret electrocardiography, including basic pathological patterns	3.50 (5-3)
Administer intravenous nutrition	3 (5-2)
Explain the types of diuretic medications	3 (4-3)
Prepare equipment for epidural and spinal catheter insertion	3 (4-2)
Prepare equipment for peripheral nerve block	3 (4-2)
Administer intralipid in cases of systemic local anesthesia toxicity	3 (4-2.75)
Assess peripheral nerve block catheter performance	3 (4-2)
Explain the anatomy and physiology of the epidural space and spinal canal	3 (4-2)
Teach the mother to breastfeed	3 (4-2)
Remove arterial catheters	3 (4-3)
Prepare equipment for dialysis catheter insertion	3 (4-2)
Prepare equipment for chest tube insertion	3 (4-2)
Assess motor function	3 (4-3)
Explain the importance of early mobilization to prevent pressure ulcers	3 (4-3)
Explain the pathophysiology of immobility	3 (4-2)
Use and interpret **TOF equipment	3 (4-2)
Explain pain management in patients with Chronic pain	3 (4-3)
Administer epidural anesthesia	3 (4-2)
Apply multimodal analgesia	3 (3-2)
Apply nonpharmacological analgesia	3 (5-3)
Explain the psychological factors that reduce pain sensitivity	3 (4-3)
Segregate the waste	3 (4-3)
Explain nonpharmacological methods to prevent thrombosis	3 (4-3)
Compare the patient's postoperative functional level with preoperative status	3 (4-2)
Explain the physiology and types of pain	3 (4-2)
Use venturi mask	3 (4-2)

*Inter Quartile Range=$Quartile_3$-$Quartile_1$. **Train Of Four

who were also offered the final results. This inclusive approach aimed to enhance the trustworthiness of our findings. Additionally, the direct involvement of clinical anesthesia instructors was sought due to their firsthand experience with students and newly qualified nurses. This firsthand knowledge enabled them to provide valuable and relevant feedback on the necessary competencies for nurses working in the PACU. While it might have been possible to consider the perspectives of PACU patients regarding the quality of care, obtaining comprehensive information from patients proved challenging due to postoperative amnesia, a common side effect of anesthesia.[4]

The first round of the Delphi study had a response rate of 94%, indicating strong interest in developing a supplementary training program for PACU care. However, the response rate decreased to 78% in the second round, which could be considered a limitation of the study. According to the literature, lower response rates in Delphi studies are often associated with the large number of items,[13] as well as factors such as respondent fatigue, reduced willingness to participate in subsequent rounds, and time constraints. However, limiting the number of learning objectives would have compromised the study's goal of identifying all essential competencies for the supplementary training program. This decline in participation was anticipated at the outset of the study. Therefore, to mitigate its potential impact, a large sample size (50 participants) was selected to account for possible attrition. As a result, despite the decrease, the remaining sample size in the second round remained statistically adequate and did not compromise the study's objectives or the validity of its findings.

Training programs should be well planned and clear to effectively equip nurses with the desired competencies. Learning objectives are essential for determining teaching methods and providing a basis for evaluating the training program.[4] Therefore, we categorized the learning objectives into four groups and proposed a suitable teaching method, as well as the number of sessions and hours required for each group. For the first group, which primarily involved cognitive knowledge and theoretical content, we suggested a lecture-based approach with four sessions of 1.5 hours. For the second group, which included familiarity with PACU equipment and advanced life support, we proposed simulation-based learning with

Table 3: Findings on teaching methods and number of sessions and training hours derived from the second round of Delphi

	Teaching method	Frequency (*n*=34), percent (100%) number (%)
Which teaching method do you suggest to achieve the learning objectives in group 1?	*PBL	10 (29.40)
	Lecture	13 (38.20)
	**Q&A	6 (17.60)
	Group discussion	5 (14.75)
How much time do you suggest to achieve the learning objectives in group 1?	two 1.5-hour sessions	5 (14.75)
	three 1.5-hour sessions	12 (35.30)
	four 1.5-hour sessions	17 (50)
Which teaching method do you suggest to achieve the learning objectives in group 2?	Role playing	16 (47.10)
	simulation	18 (52.90)
How much time do you suggest to achieve the learning objectives in group 2?	one 1-hour session	10 (29.40)
	two 1.5-hour sessions	13 (38.20)
	two 2-hour sessions	11 (32.40)
Which teaching method do you suggest to achieve the learning objectives in group 3?	Movie playback and group discussion	20 (58.80)
	**Q&A	15 (14.70)
	Lecture	4 (11.80)
	Simulation	5 (14.70)
How much time do you suggest to achieve the learning objectives in group 3?	one 1.5-hour session	12 (35.30)
	two 1.5-hour sessions	22 (64.70)
Which teaching method do you suggest to achieve the learning objectives in group 4?	***CBL	17 (50)
	Role playing	14 (41.2)
	Movie playback	3 (8.80)
How much time do you suggest to achieve the learning objectives in group 4?	one 1.5-hour session	15 (44.10)
	two 1.5-hour sessions	19 (55.90)

*Problem-Based Learning. **Question and Answer. ***Case-Based Learning

two sessions of 1.5 hours. For the third group, which involved performing care procedures and evaluating various patient-connected equipment, we suggested Movie playback followed by group discussions, with two sessions of 1.5 hours. Finally, for the fourth group, which included documentation and patient communication, we proposed a Case-Based Learning (CBL) approach with two sessions of 1.5 hours. In total, the proposed supplementary training program requires 10 sessions, equivalent to 15 hours. In this program, practical considerations, especially time constraints and nursing staff shortages in clinical settings, were taken into account. As a result, the course structure was designed to minimize the number of sessions and total instructional hours, ensuring that its implementation causes minimal disruption to nurses' workflow. Additionally, the incorporation of diverse teaching methods enabled the possibility of blended learning (in-person and online sessions), thereby mitigating time constraints. In a study conducted by another research group in 2022, a small group workshop approach was suggested for teaching all the identified competencies.[14] In contrast, our study distinguishes itself by categorizing core competency-based learning objectives separately and proposing a unique teaching method for each category.

The American Society of Peri-Anesthesia Nurses (ASPAN) and the National Health Service (NHS) of Scotland have established comprehensive standards as competencies for PACU nurses, based on previous literature or appointed expert panels (as cited in Hvidberg *et al*., 2021).[4] Although these standards have not been created for the design of a supplementary training program, they reinforce our findings. In the meantime, our results contribute to the ASPAN and NHS Scotland standards as the training program we designed is practical and implementable for training PACU anesthesia nurses. In addition, the results of the study by Hvidberg *et al*. (2021)[4] align closely with our study in terms of the identified learning objectives. However, our study identified 95 learning objectives and specified the teaching methods and required number of sessions, while the Hvidberg study identified 180 learning objectives without specifying teaching methods or session numbers.

In a nutshell, our study has developed a comprehensive supplementary training program for PACU care, encompassing detailed information on teaching methods and the required number of sessions, determined through the Delphi method. This study faced a number of limitations. One significant limitation was the reduced response rate in the second round of the Delphi process, which may have

affected the consensus strength on the identified learning objectives. Another major limitation was the exclusion of patient perspectives in defining the learning objectives, which could have enriched the content and ensured alignment with patient-centered care principles. Finally, access to a broader and more diverse sample was restricted. Specifically, clinical educators and anesthesia nursing experts from other countries were not included in the Delphi panel, which limits the generalizability of the findings across different healthcare systems and cultural contexts. Future research should address these by engaging a larger expert panel and incorporating patient views in objective development. Subsequent studies should then focus on implementing and evaluating the program's effectiveness in enhancing PACU anesthesia nurses' clinical competence through pre- and post-training assessments. Furthermore, adapting and testing the program across diverse healthcare systems will enable necessary modifications for resource availability and cultural variations. Integrating competency-based PACU training into standard nursing education programs could ensure long-term sustainability and professional integration. Addressing these points will refine the program, broaden its applicability, and contribute to standardizing PACU nursing education.

Conclusion

Employing the Delphi method, we developed a comprehensive supplementary training program for PACU care, designed to elevate the clinical competence of anesthesia nurses. This program, encompassing four groups with 95 learning objectives, appropriate teaching methods, and a specified number of sessions and hours, has the potential for application in training and enhancing the clinical competence of PACU anesthesia nurses. However, considering that this study has only provided a general framework for the educational program, implementing it in different healthcare systems may require comparative studies to evaluate cultural differences, resource availability, and the role of PACU nurses in various settings.

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Conflicts of interest

Nothing to declare.

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