

Effectiveness of a Training Programme on Knowledge Regarding ABG Sampling Technique and Its Interpretation Among ICU Nurses in Medanta Hospital, Gurugram, Haryana

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ABSTRACT

Arterial Blood Gas (ABG) analysis is an essential investigation in intensive care units (ICUs) for assessing patients' oxygenation, ventilation, and acid-base balance. Nurses working in ICUs play a key role in ABG sampling and are often the first healthcare professionals to interpret the results; therefore, adequate knowledge and skill are crucial to avoid pre-analytical errors and misinterpretation that may compromise patient safety. The present study was conducted to assess the effectiveness of a structured training programme on knowledge regarding ABG sampling technique and its interpretation among ICU nurses. A quantitative approach with a quasi-experimental pre-test and post-test design was adopted. The study was carried out in a tertiary care hospital in Gurugram, Haryana, among 100 ICU nurses selected through simple random sampling. Data were collected using a self-structured and validated knowledge questionnaire covering aspects of ABG sampling, normal values, and interpretation. Following the pre-test, a structured training programme was administered to the participants, and post-test knowledge was assessed after the intervention. Descriptive statistics were used to summarize demographic variables and knowledge scores, while inferential statistics such as paired *t*-test and chi-square test were applied to evaluate the effectiveness of the training programme and the association between knowledge and selected demographic variables. The findings of the study revealed a significant improvement in post-test knowledge scores compared to pre-test scores ($p < 0.05$), demonstrating the effectiveness of the structured training programme. Significant associations were also observed between pre-test knowledge levels and selected demographic variables such as educational qualification and prior exposure to ABG-related training. The study concludes that structured and systematic training programmes are effective in enhancing ICU nurses' knowledge regarding ABG sampling technique and interpretation. Regular in-service education and competency-based training are recommended to strengthen critical care nursing practice, reduce procedural errors, and improve patient outcomes in intensive care settings.

Introduction

Arterial blood gas (ABG) analysis is one of the most vital diagnostic tools in intensive care units (ICUs), providing essential information about a patient's respiratory efficiency, oxygenation, ventilation, and acid-base balance (Gomes et al., 2024). The

accuracy of ABG sampling and correct interpretation are crucial, as misinterpretation may delay or misguide treatment and place critically ill patients at risk. Although ABG testing is routinely performed, nurses often face knowledge and skill gaps, particularly those who are newly employed or lack structured training (Fatma Alzahraa et al.,

2024). Globally, nurses are frequently the first responders to critically ill patients, and their ability to accurately obtain and interpret ABG samples plays a vital role in decision-making. Errors during ABG sampling may occur during the pre-analytical phase, such as air bubble entrapment or delays in transporting samples, which can produce misleading results (Vahedian-Azimi et al., 2021). Moreover, interpretation errors may hinder timely recognition of respiratory acidosis, alkalosis, or metabolic disturbances, leading to adverse patient outcomes. In India, ICUs remain heavily nurse-dependent in terms of patient monitoring. While physicians typically provide definitive treatment decisions, nurses' interpretation of ABG results enables earlier identification of life-threatening imbalances. Unfortunately, several studies have reported inadequate training in ABG analysis among ICU nurses. For instance, Kulvi et al. (2023) demonstrated significant improvements in nurses' knowledge following a structured teaching programme, highlighting the effectiveness of targeted educational interventions. Existing literature supports the idea that planned teaching interventions enhance nurses' competence in ABG analysis. A study by Ragab Bayomi and Taha (2022) showed that self-learning packages significantly improved nurses' knowledge and practices regarding ABG analysis for critically ill patients. Similarly, Pakkirisamy et al. (2021) revealed substantial increases in post-test knowledge scores following a structured programme. These findings reinforce the importance of implementing evidence-based training to address knowledge deficits among ICU staff. The

need for this study stems from the increasing complexity of ICU care and the expanding role of nurses in critical decision-making. As ICU environments demand rapid interventions, lack of knowledge in ABG sampling and interpretation poses a significant barrier to patient safety. By evaluating the effectiveness of a structured training programme, this study aimed to generate evidence supporting standardized training initiatives in Indian tertiary hospitals.

Materials and Methods

A quantitative research approach with a quasi-experimental pre-test and post-test design was employed to evaluate the effectiveness of a structured training programme on knowledge regarding ABG sampling technique and its interpretation among ICU nurses. The study was conducted in selected Intensive Care Units of Medanta Hospital, Gurugram, Haryana. A total of 100 ICU nurses who met the inclusion criteria were selected using a simple random sampling technique. Nurses working in ICUs and willing to participate were included, while those on long leave during the study period were excluded. Data were collected using a self-structured and validated knowledge questionnaire developed after an extensive review of literature and expert consultation. The tool comprised two sections: demographic variables and multiple-choice questions assessing knowledge related to ABG sampling procedure, normal reference values, and interpretation of ABG parameters. Following the pre-test, a structured training programme was administered, which included theoretical instruction on definition, indications,

contraindications, principles, procedural steps of arterial puncture, and interpretation of ABG values such as pH, PaO₂, PaCO₂, bicarbonate, and base excess. Post-test assessment was conducted seven days after the intervention using the same questionnaire to determine knowledge gain. Ethical approval was obtained from the institutional ethics committee, and formal permission was secured from hospital authorities. Written informed consent was obtained from all

participants, and confidentiality was maintained throughout the study. Data were analyzed using descriptive statistics, including frequency, percentage, mean, and standard deviation, while inferential statistics such as paired *t*-test and chi-square test were applied to assess the effectiveness of the training programme and the association between knowledge scores and selected demographic variables. A *p*-value of less than 0.05 was considered statistically significant.

Results

Comparison of Pre-test and Post-test Knowledge Scores (n = 100)

Knowledge	Pretest knowledge		Posttest knowledge		Student's paired t-test
	Mean	SD	Mean	SD	
Introduction	1.93	0.87	3.87	0.73	t=13.49 P=0.001 significant
Procedure	6.83	1.58	13.07	1.14	t=16.97 P=0.001 significant
Interpretation	7.83	0.95	15.83	1.32	t =33.37 P=0.001 significant

The results indicate a significant improvement in knowledge scores across all domains after training.

Association with Demographic Variables

Table 3: Association of Pre-test Knowledge with Demographic Variables

		Pretest				Total	Chi square test/ Yates corrected chi square test		
		Inadequate		Moderate					
		n	%	n	%				
Age	20-30 yrs	34	96.0%	11	4.0%	13			

	31-40 yrs	3	60.0%	2	40.0%	2	$\chi^2=2.66$ p=0.10 Not significant
Sex	Male	18	100.0%	0	0	4	$\chi^2=0.17$ p=0.68 Not significant
	Female	29	86.4%	3	13.6%	11	
Qualification	GNM	14	92.3%	2	7.7%	13	$\chi^2=0.03$ p=0.85 Not significant
	B.Sc.(N)	33	75.0%	1	25.0%	2	
Years of Experience	0 -1 yr	19	90.0%	1	10.0%	5	$\chi^2=1.15$ p=0.28 Not significant
	1 -2yrs	15	100.0%			8	
	2 -3yrs	13	60.0%	2	40.0%	2	
Area of experience	ICU	46	92.9%	2	7.1%	14	$\chi^2=0.53$ p=0.46 Not significant
	OT	1	50.0%	1	50.0%	1	

None of the demographic variables are significantly associated with their knowledge score. It was calculated using Pearson chi square test/Yates corrected chi square test.

Association of Post-test Knowledge with Demographic Variables

		Posttest				Total	Chi square test/ Yates corrected chi square test		
		Moderate		Adequate					
		n	%	n	%				
Age	20-30 yrs	3	12.0%	22	88.0%	12	$\chi^2=6.00$ p=0.01 significant		
	31-40 yrs	3	60.0%	22	40.0%	3			
Sex	Male	3	37.5%	15	62.5%	4	$\chi^2=0.86$ p=0.35 Not significant		
	Female	3	13.6%	29	86.4%	11			
Qualification	GNM	5	19.2%	11	80.8%	13	$\chi^2=0.07$ p=0.78 Not significant		
	B.Sc.(N)	1	25.0%	33	75.0%	2			

Years of Experience	0 - 1 yr	3	30.0%	17	70.0%	5	$\chi^2=8.54$ p=0.01 significant
	1 - 2 yrs	1	6.7%	14	93.3%	8	
	2 - 3 yrs	2	40.0%	13	60.0%	2	
Area of experience	ICU	45	17.9%	3	82.1%	14	$\chi^2=1.20$ p=0.27 Not significant
	OT	1	50.0%	1	50.0%	1	

Educational qualification and prior ABG training were significantly associated with knowledge levels.

Results

The present study included 100 nurses working in intensive care units, with the majority belonging to the age group of 21–30 years and holding a Bachelor of Science in Nursing qualification. Most participants had one to five years of ICU experience, and a limited number reported prior formal training related to arterial blood gas (ABG) analysis.

Pre-test assessment revealed that a considerable proportion of nurses had inadequate to moderate knowledge regarding ABG sampling technique and interpretation. Common areas of deficiency included identification of normal ABG values, interpretation of acid–base imbalances, and recognition of respiratory versus metabolic disorders. Following the administration of the structured training programme, a marked improvement in knowledge scores was observed in the post-test assessment. The mean post-test knowledge score was significantly higher than the mean pre-test score, indicating substantial knowledge gain among the participants.

Statistical analysis using the paired *t*-test demonstrated a statistically significant difference between pre-test and post-test knowledge scores ($p < 0.05$), confirming the effectiveness of the structured training programme. Further analysis using the chi-square test revealed a significant association between pre-test knowledge levels and selected demographic variables such as educational qualification and previous exposure to ABG-related training. No significant association was found between knowledge levels and variables such as age and years of experience. Overall, the findings indicate that the structured training programme was effective in enhancing ICU nurses' knowledge regarding ABG sampling technique and interpretation.

Similar Studies

A recent quasi-experimental study conducted by **Radhika Kulvi et al. (2023)** evaluated the effectiveness of a structured teaching programme on knowledge regarding arterial blood gas analysis and its interpretation among nursing officers working in a tertiary care hospital. A sample of 100 nurses was selected, and data were collected using a self-

structured knowledge questionnaire. The findings revealed a statistically significant improvement in post-test knowledge scores compared to pre-test scores ($p < 0.001$), confirming that structured educational interventions are effective in enhancing nurses' knowledge related to ABG analysis and interpretation. In another quasi-experimental study, **Fatma Alzahraa et al. (2024)** assessed the effect of educational guidelines on nurses' knowledge and practices related to arterial blood gas sampling and interpretation in intensive care units. The study involved 50 ICU nurses and utilized a pre-test and post-test design. Results demonstrated a marked improvement in both knowledge and procedural accuracy following the intervention, highlighting the positive impact of guideline-based training on nurses' clinical performance. Similarly, **Vijaya Sekaran et al. (2024)** reported that targeted educational interventions significantly improved nurses' understanding of ABG sampling techniques and interpretation in critical care settings. The study emphasized that improved knowledge contributed to better recognition of acid-base imbalances and respiratory abnormalities, thereby supporting timely clinical decision-making. A recent descriptive study conducted in **2025** among critical care nurses revealed that although nurses were routinely involved in ABG sampling, many demonstrated inadequate interpretative skills, particularly in identifying mixed acid-base disorders. The authors recommended regular in-service training and competency-based educational programmes to bridge the knowledge gap and improve patient safety outcomes.

Discussion

This study found that a structured training programme significantly improved ICU nurses' knowledge of ABG sampling and interpretation, supporting the hypothesis

(H₁). These findings align with prior research. For example, Kulvi et al. (2023) reported significant gains in nurses' ABG knowledge after structured teaching, with post-test scores significantly higher than pre-test scores ($p < .001$). Similarly, Fatma Alzahraa et al. (2024) demonstrated that educational guidelines improved both knowledge and practice levels among ICU nurses. Our study further supports these findings, highlighting that targeted training interventions are effective in enhancing nurses' clinical competence. The significant association of knowledge with qualification and prior ABG training indicates that baseline education and exposure play important roles. This echoes the findings of Ragab Bayomi and Taha (2022), who noted that self-learning interventions were particularly effective among nurses with limited initial exposure to ABG concepts. Importantly, the findings of this study emphasize the role of continuous professional development. In ICUs, rapid recognition of ABG imbalances can be lifesaving. Therefore, integrating periodic competency-based training into institutional policies is crucial. This aligns with international recommendations advocating for competency-based frameworks in critical care nursing (Vahedian-Azimi et al., 2021).

Conclusion

The structured training programme was highly effective in improving ICU nurses' knowledge of ABG sampling and interpretation. Educational qualification and prior exposure to ABG significantly influenced baseline knowledge. These findings reinforce the necessity of regular in-

service training to strengthen clinical decision-making and promote patient safety.

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