

Effect Of Planned Teaching Program On Knowledge Regarding Arterial Blood Gas Analysis And Its Application Among Nurses Working In Intensive Care Unit

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Abstract:

Background: Arterial blood gas (ABG) analysis is an essential diagnostic test used to assess ventilation, gas exchange, and acid–base balance. It is commonly performed by obtaining arterial blood using a heparinized syringe. Accurate interpretation and application of ABG analysis are critical competencies for staff nurses involved in the care of critically ill patients. This study was undertaken to evaluate the effectiveness of a planned teaching programme (PTP) in improving the knowledge of staff nurses regarding arterial blood gas analysis and its clinical application.

Materials and Methods: A quantitative, evaluative, pre-experimental one-group pre-test–post-test research design was adopted. The study was conducted among 52 ICU staff nurses selected through purposive sampling from IQ City Medical College and Hospital, Durgapur, Paschim Bardhaman, West Bengal. A pilot study was carried out at Health world Hospitals, Durgapur, to establish the feasibility and reliability of the research tool. Baseline knowledge was assessed using a structured questionnaire, followed by the administration of a planned teaching programme on Day 1. A post-test was conducted on the seventh day using the same instrument. The study also examined the association between pre-test knowledge scores and selected demographic variables.

Results: The planned teaching programme significantly improved the knowledge of staff nurses regarding arterial blood gas analysis and its application. The mean pre-test knowledge score was 25.06 ± 4.12 , which increased to 26.94 ± 4.09 in the post-test. The difference was statistically significant ($t = 2.01$, $p < 0.05$), demonstrating the effectiveness of the teaching programme. A significant association was observed between pre-test knowledge scores and selected demographic variables, namely educational qualification and total years of professional experience.

Conclusion: The planned teaching programme was effective in enhancing the knowledge of staff nurses regarding arterial blood gas analysis and its clinical application. Regular educational interventions can strengthen nurses' competency in ABG interpretation and management, thereby contributing to improved patient care outcomes. Similar educational programmes should be incorporated into continuing nursing education to enhance professional knowledge and clinical practice across various nursing specialties.

Keywords: Staff nurses, Knowledge regarding arterial blood gas analysis and it's application, Planned Teaching Program

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I. Introduction

Nurses play a vital role in the early identification and management of acid–base imbalances in critically ill patients. In intensive care units (ICUs), arterial blood gas (ABG) analysis is an essential diagnostic tool that assists nurses in monitoring ventilation, oxygenation, and acid–base status, thereby supporting timely clinical decision-making and improving patient outcomes.¹ Arterial blood gas analysis measures blood pH, partial pressure of oxygen (PaO₂), partial pressure of carbon dioxide (PaCO₂), bicarbonate (HCO₃⁻), and oxygen saturation (SaO₂), providing valuable information on respiratory and metabolic status.² Normal ABG values include a pH of 7.35–7.45, PaO₂ of 75–100 mmHg, PaCO₂ of 35–45 mmHg, HCO₃⁻ of 22–26 mEq/L, and SaO₂ of 95–100%.³ Accurate interpretation of these parameters is essential for assessing acid–base disorders, evaluating treatment response, and monitoring disease progression.⁴

Despite its clinical importance, studies have reported inadequate knowledge and skills among nurses in interpreting ABG results accurately.^{5,6} Poor interpretation may lead to delayed diagnosis and serious complications, including respiratory failure, electrolyte imbalance, cardiac arrhythmias, organ dysfunction, coma, and death.⁷ Therefore, nurses require a sound understanding of ventilation, oxygenation, acid–base balance, and

compensatory mechanisms to interpret ABG findings effectively.⁸ Although continuing education programmes are available, gaps in nurses' competency regarding ABG analysis still persist.⁹ Hence, the current study was undertaken to assess the effectiveness of a planned teaching programme on the knowledge of staff nurses regarding arterial blood gas analysis and its clinical application.

II. Material And Methods

This pre- experimental one group pretest- post- test study was conducted in IQ City medical College Hospital, Durgapur, West Bengal from 16th February to 17th February 2025. 52 Staff nurses of both male and females were selected for this study.

Study Design: Pre- experimental one group pretest- post- test study

Study Location: This study was conducted in a tertiary care hospital named IQ City Medical College Hospital, Durgapur, West Bengal.

Study Duration: February 16th to February 25th, 2025

Sample size: 52 ICU Staff Nurses.

Sample size calculation: The sample size was calculated for a one-group pre-test–post-test design using a significance level of 5% ($\alpha = 0.05$), a power of 80% ($1-\beta = 0.80$), an expected effect size of 5, and a standard deviation of 8.6. The estimated sample size was 47 participants. After adding a 10% allowance for non-response, the final sample size was determined to be 52 staff nurses.

Subjects & selection method: The study was conducted among ICU staff nurses working at IQ City Medical College and Hospital, Durgapur, West Bengal. A total of 150 ICU staff nurses constituted the study population. Simple random sampling was used to select the study participants. Nurses of both genders who were available during the data collection period and willing to participate were included, while those who had previously attended an arterial blood gas (ABG) analysis training programme or were unwilling to participate were excluded. Based on the sample size calculation and after allowing for a 10% non-response rate, a total of 52 staff nurses were selected for the study.

Inclusion Criteria:

- Nurses of both genders were included.
- Nurses who were available during data collection period.

Exclusion Criteria:

- Nurses who were attended arterial blood gas analysis class previously.
- Nurses who were not willing to participate.

Procedure methodology: A quantitative, pre-experimental one-group pre-test–post-test research design was adopted to evaluate the effectiveness of a planned teaching programme (PTP) on knowledge regarding arterial blood gas (ABG) analysis and its application among staff nurses. The study was conducted at IQ City Medical College and Hospital, Durgapur, West Bengal, after obtaining administrative approval from the Medical Superintendent and ethical clearance from the Institutional Ethics Committee (Ref. No. IQMC/IEC-18/LTR/2).

The study population comprised 150 staff nurses, from whom 52 participants were selected using a simple random sampling technique. Nurses of both genders who were available during the data collection period and willing to participate were included in the study. Nurses who had previously attended training on ABG analysis or were unwilling to participate were excluded. Written informed consent was obtained from all participants before data collection.

Baseline knowledge was assessed using a self-administered structured questionnaire on 17 February 2025. Immediately following the pre-test, participants received a 45-minute planned teaching programme using PowerPoint presentations, pamphlets, and handouts. The programme covered the concepts, components, indications, interpretation, clinical application, and nursing responsibilities related to ABG analysis. A post-test was conducted seven days later (24 February 2025) using the same questionnaire to assess the effectiveness of the intervention.

Statistical analysis: The collected data were coded, entered into Microsoft Excel, and analyzed using IBM SPSS Statistics version 25.0. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were

used to summarize the demographic characteristics and knowledge scores of the participants. Inferential statistics were applied to test the study hypotheses. A paired *t*-test was used to compare the pre-test and post-test knowledge scores, while the Chi-square test was used to determine the association between pre-test knowledge scores and selected demographic variables. A *p*-value of <0.05 was considered statistically significant.

III. Results:

A total of 52 staff nurses participated in the study. The majority were aged 21–30 years (80.8%), female (82.7%), unmarried (59.6%), and General Nursing and Midwifery (GNM) qualified (73.1%). Most participants were working in the Medical ICU (34.6%), had 1–5 years of experience in the present hospital (71.2%), and 1–5 years of total professional experience (59.6%) (Table 1).

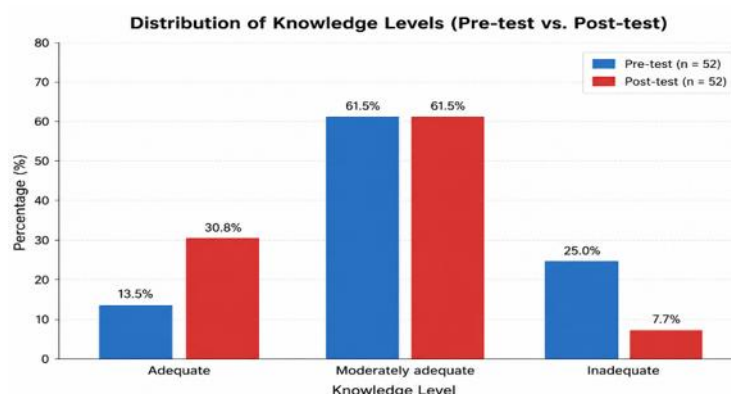
Table 1. Demographic characteristics of the participants (N = 52)

Sn	Variables	n (%)
1	Age 21–30 years	42 (80.8)
2	Female	43 (82.7)
3	Unmarried	31 (59.6)
4	GNM qualification	38 (73.1)
5	Medical ICU	18 (34.6)
6	1–5 years' experience (present hospital)	37 (71.2)
7	1–5 years' total experience	31 (59.6)

Before the intervention, 61.5% of the nurses had moderately adequate knowledge, 25.0% had inadequate knowledge, and 13.5% had adequate knowledge regarding ABG analysis. Following the planned teaching programme, the proportion of nurses with adequate knowledge increased to 30.8%, while inadequate knowledge decreased to 7.7% (Table 2).

Table 2. Distribution of knowledge levels before and after the planned teaching programme

Knowledge level	Pre-test n (%)	Post-test n (%)
Adequate	7 (13.5)	16 (30.8)
Moderately adequate	32 (61.5)	32 (61.5)
Inadequate	13 (25.0)	4 (7.7)



The mean knowledge score significantly increased from 25.06 ± 4.12 in the pre-test to 26.94 ± 4.09 in the post-test. The mean difference was 1.88, and the improvement was statistically significant ($t = 5.023$, $p < 0.001$), indicating the effectiveness of the planned teaching programme (Table 3).

Table 3. Comparison of pre-test and post-test knowledge scores (N = 52)

Test	Mean $\pm$ SD	Mean difference	<i>t</i> value	<i>p</i> value
Pre-test	25.06 ± 4.12			
Post-test	26.94 ± 4.09	1.88	5.023	<0.001*

Significant at $p < 0.05$.

Analysis of the association between baseline knowledge and demographic variables showed that educational qualification ($\chi^2 = 4.038$, $p = 0.044$) and total years of professional experience ($\chi^2 = 4.912$, $p = 0.027$) were significantly associated with pre-test knowledge scores. No significant association was observed with age, gender, marital status, department of work, or years of experience in the present hospital (Table 4).

Table 4. Association between pre-test knowledge and selected demographic variables

Variable	χ^2	<i>p</i> value	Significance
Educational qualification	4.038	0.044	Significant
Total years of experience	4.912	0.027	Significant
Age	0.547	0.459	Not significant
Gender	3.123	0.077	Not significant
Marital status	2.105	0.146	Not significant
Department of work	0.122	0.762	Not significant
Years of experience in present hospital	0.001	0.977	Not significant

IV. Discussion:

The majority of the participants were aged 21–30 years (80.77%), indicating that the ICU workforce consisted predominantly of young nurses. This finding is comparable with Ahmed et al., who reported that 62.5% of nurses belonged to the 26–30-year age group ⁽¹¹⁾, and Upreti and Mishra, who observed that most participants were younger than 25 years ⁽¹⁷⁾. However, Pakkirisamy reported that the majority of nurses were in the 31–40-year age group ⁽¹³⁾. Female nurses constituted the majority (82.69%) of the participants, which is consistent with the findings of Pakkirisamy ⁽¹³⁾ and Upreti and Mishra ⁽¹⁷⁾.

Most participants were GNM-qualified nurses (73.08%), similar to the findings reported by Ahmed et al. ⁽¹¹⁾ and Pakkirisamy ⁽¹³⁾. In contrast, Upreti and Mishra reported a higher proportion of B.Sc. Nursing graduates ⁽¹⁷⁾. The majority of nurses had 1–5 years of professional experience, which is comparable to the studies conducted by Ahmed et al. ⁽¹⁰⁾, Pakkirisamy ⁽¹³⁾, and Upreti and Mishra ⁽¹⁷⁾.

Following the planned teaching programme, the proportion of nurses with adequate knowledge increased considerably, while inadequate knowledge decreased, demonstrating the effectiveness of the educational intervention. Similar improvements have been reported by Kulvi ⁽¹⁰⁾, Karpukkarasi and Arasumani ⁽¹²⁾, Pakkirisamy ⁽¹³⁾, Negi and Verma and Begum et al. ⁽¹⁹⁾.

The present study demonstrated that the planned teaching programme was effective in improving the knowledge of staff nurses regarding arterial blood gas (ABG) analysis and its application. The mean post-test knowledge score (26.94 ± 4.09) was significantly higher than the mean pre-test score (25.06 ± 4.12), with a mean difference of 1.88. The improvement was statistically significant ($t = 5.023$, $p < 0.05$), indicating that the observed increase in knowledge was attributable to the planned teaching programme rather than chance. Therefore, the null hypothesis (H_{01}), which stated that there would be no significant difference between the pre-test and post-test knowledge scores, was rejected.

The findings of the present study are consistent with those of Kulvi (2024), who reported a statistically significant increase in post-test knowledge scores following a structured teaching programme on ABG analysis among nursing officers, confirming the effectiveness of educational interventions in improving nurses' knowledge ⁽¹⁰⁾. Similarly, Karpukkarasi and Arasumani (2024) observed a marked improvement in knowledge after structured teaching, with the majority of participants achieving adequate knowledge in the post-test compared to none in the pre-test ⁽¹²⁾.

Pakkirisamy (2021) also demonstrated a significant increase in knowledge following a planned teaching programme, concluding that educational intervention effectively enhanced nurses' understanding of ABG analysis ⁽⁴⁴⁾.

Comparable findings were reported by Negi and Verma (2021), who found that a structured teaching programme significantly improved both knowledge and clinical practice related to ABG analysis and interpretation among nursing personnel. Likewise, Begum et al. (2019) concluded that a structured teaching programme effectively increased the knowledge level of ICU nurses regarding ABG analysis ⁽¹⁹⁾. The consistency of these findings across different healthcare settings provides strong evidence that structured educational programmes are an effective strategy for strengthening nurses' competency in ABG analysis and interpretation.

The present study examined the association between selected demographic variables and the pre-test knowledge regarding arterial blood gas (ABG) analysis and its application among staff nurses. The findings demonstrated that professional qualification and total years of experience were significantly associated with the pre-test knowledge level, whereas age, gender, marital status, department of working, and years of experience in the present hospital showed no statistically significant association.

In the present study, nurses possessing B.Sc. Nursing and Post Basic B.Sc. Nursing qualifications demonstrated significantly better pre-test knowledge than GNM-qualified nurses ($\chi^2 = 4.038$, $p = 0.044$). This finding suggests that higher nursing education may provide a stronger theoretical foundation and greater exposure to critical care concepts, including ABG analysis and interpretation. The finding is supported by Begum et al. (2019), who reported a significant association between professional qualification and pre-test knowledge regarding ABG analysis ⁽¹⁹⁾. Similarly, Bagul (2021) found that nurses with higher educational qualifications exhibited greater improvement in knowledge following a planned teaching programme ⁽¹⁵⁾. Sachan and Das (2021) also reported a significant association between qualification and post-test knowledge among staff nurses after a

structured teaching programme ⁽¹⁴⁾. These findings collectively indicate that educational qualification plays an important role in determining nurses' baseline competency and their ability to acquire advanced clinical knowledge.

The present study also found a significant association between total years of professional experience and pre-test knowledge ($\chi^2 = 4.912, p = 0.027$). Professional experience provides repeated exposure to critically ill patients and interpretation of laboratory investigations, thereby improving nurses' understanding of ABG analysis. This finding is consistent with Begum et al. (2019), who reported that total working experience was significantly associated with nurses' knowledge regarding ABG analysis ⁽¹⁹⁾. Likewise, Bagul (2021) observed that nurses with greater years of experience demonstrated better knowledge gains following educational intervention ⁽¹⁵⁾. Mandal (2020) also reported a significant association between years of experience and knowledge scores among staff nurses ⁽¹⁶⁾. These findings emphasize that cumulative clinical exposure enhances nurses' confidence and competence in interpreting arterial blood gas reports.

Conversely, the present study found no statistically significant association between age, gender, marital status, department of working, or years of experience in the present hospital and pre-test knowledge levels. Similar findings were reported by Mokhale (2020), who found no significant association between knowledge and baseline variables such as age, gender, professional qualification, duration of clinical experience, or area of clinical experience ⁽¹⁸⁾. Bagul (2021) also reported that age was not significantly associated with knowledge improvement ⁽¹⁵⁾. These observations suggest that demographic characteristics alone may not influence nurses' knowledge regarding ABG analysis, whereas educational preparation and cumulative professional experience appear to be more important determinants.

Overall, the findings indicate that nurses with higher educational qualifications and greater professional experience possess better baseline knowledge regarding ABG analysis and its clinical application. Therefore, regular continuing nursing education (CNE), structured teaching programmes, and competency-based training should be implemented, particularly for newly recruited and GNM-qualified nurses, to strengthen their knowledge and improve the quality of critical care practice

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