

Knowledge and Practice of Nurses Regarding The Use of Low Flow Oxygen Therapy and Humidification at Tertiary Care Hospital, Lahore

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Abstract

Background Low-flow oxygen therapy and humidification are essential interventions in the management of patients with respiratory compromise. Nurses play a critical role in ensuring safe oxygen administration, yet gaps between knowledge and clinical practice remain a concern in healthcare settings. **Aim** The study aimed to assess nurses' knowledge and practices regarding low-flow oxygen therapy and humidification at a tertiary care hospital in Lahore. **Methods** A quantitative cross-sectional study design was used. A total of 133 registered nurses were selected through convenient sampling from emergency, ICU, and ward settings. Data were collected using an adopted structured questionnaire consisting of demographic data, knowledge, and practice items. Analysis was performed using SPSS version 23 with descriptive statistics including frequencies and percentages. **Results** Findings showed that 54.1% of

nurses had good knowledge of low-flow oxygen therapy and humidification. However, only 33.1% consistently followed recommended clinical practices. Knowledge scores were higher than practice scores, indicating a clear gap between theoretical understanding and clinical implementation. **Conclusion** The study concludes that nurses possess adequate knowledge but demonstrate inadequate and inconsistent practices regarding low-flow oxygen therapy and humidification. Continuous training, standardized protocols, and supervision are recommended to improve clinical performance and patient safety.

Keywords Low-flow oxygen therapy, humidification, nurses, knowledge, practice, tertiary care hospital, respiratory care.

INTRODUCTION

Oxygen is a colorless, odorless, and tasteless gas with the atomic number 8 that is essential for cellular metabolism and survival. Oxygen therapy refers to the administration of supplemental oxygen to patients with inadequate oxygenation in order to maintain normal tissue oxygen levels. Low-flow oxygen therapy is a method of oxygen delivery that provides oxygen at flow rates lower than the patient's inspiratory demand through devices such as nasal cannulas and face masks. Humidification is the process of adding moisture to oxygen before administration to prevent airway dryness and secretion thickening. Nurses are responsible for monitoring oxygen delivery systems and preventing complications associated with oxygen therapy (Duprez et al., 2022; Vekinis, 2023).

Respiratory diseases remain a major cause of morbidity and mortality worldwide. Chronic respiratory diseases, pneumonia, asthma, and COVID-19 continue to increase the demand for oxygen therapy in healthcare settings. Hypoxemia is commonly reported among critically ill and post-operative patients requiring immediate oxygen support. Global healthcare systems experienced increased oxygen demand during the

COVID-19 pandemic, particularly in intensive care and emergency units (Romero-Sánchez et al., 2022; Castellano et al., 2022).

In Pakistan, respiratory illnesses including chronic obstructive pulmonary disease (COPD), tuberculosis, asthma, and pneumonia contribute significantly to hospital admissions. Tertiary care hospitals frequently manage patients requiring low-flow oxygen therapy in medical, surgical, pediatric, and intensive care units. Studies conducted in Pakistani healthcare settings reported insufficient nursing knowledge and inconsistent practices regarding oxygen administration and humidification. Local healthcare facilities continue to face challenges related to inadequate training and limited adherence to oxygen therapy protocols (Sivanandan et al., 2025; Karunarathna et al.).

Low-flow oxygen therapy is commonly used for patients with mild to moderate hypoxemia. Nasal cannulas provide oxygen concentrations ranging from 24% to 44% at flow rates of 1–6 L/min, while simple face masks deliver FiO₂ concentrations between 40% and 60%. Partial rebreather and non-rebreather masks provide higher oxygen concentrations for patients requiring greater respiratory support. Incorrect oxygen administration may result in complications including oxygen toxicity, carbon dioxide retention, and ineffective tissue oxygenation (Kimario et al., 2025; Reabow, 2024).

Humidification is an important component of oxygen therapy because dry oxygen can damage respiratory mucosa and impair airway clearance. Oxygen administered over prolonged periods bypasses the natural humidification process of the upper airway, causing dryness, nasal irritation, thickened secretions, and inflammation. Bubble humidifiers are commonly used in low-flow oxygen systems to maintain airway moisture and improve patient comfort during therapy (Islam, 2025; Fagondes et al., 2025).

Patients with chronic respiratory diseases, tracheostomies, and mechanical ventilation require adequate humidification to maintain airway integrity. Moisture helps thin respiratory secretions and reduces airway obstruction, especially among patients with COPD, pneumonia, and cystic fibrosis. Studies conducted internationally demonstrated deficiencies in healthcare professionals' knowledge and practices related to oxygen administration, oxygen monitoring, and humidification techniques. Inadequate training and lack of updated clinical guidelines contributed to unsafe oxygen therapy practices in healthcare institutions (Chen, 2025; Romero-Sánchez et al., 2022).

Research conducted in Nigeria revealed that although healthcare professionals demonstrated adequate theoretical knowledge regarding oxygen therapy, only a small percentage followed recommended clinical practices. Similar gaps between knowledge and practice were identified in developing countries where healthcare workers lacked competency in selecting appropriate oxygen delivery devices and monitoring patient responses. Nurses play a critical role in ensuring safe oxygen administration and preventing respiratory complications among hospitalized patients (Members et al., 2025; Fu et al., 2025).

Limited local research exists regarding nurses' knowledge and practices about low-flow oxygen therapy associated with humidification in tertiary care hospitals. Deficiencies in nursing competency may increase the risk of hypoxia, airway complications, prolonged hospitalization, and patient discomfort. Assessment of nurses' knowledge and practices is necessary to identify existing gaps and support the development of targeted educational and clinical training programs aimed at improving respiratory care outcomes and patient safety (Kaminsky, 2025; Duprez et al., 2022).

Method

A quantitative cross-sectional study design was used to assess nurses' knowledge and practices regarding low-flow oxygen therapy and humidification at a tertiary care hospital in Lahore. The study was conducted in the departments of Medical and Surgical Emergency, Intensive Care Unit (ICU), and hospital wards. The target population included all registered nurses directly involved in administering oxygen therapy to patients. A convenient sampling technique was applied to recruit participants. The sample size consisted of 133 nurses and was calculated using Slovin's formula from a total population of 200 nurses. Nurses having at least six months of clinical experience and willingness to participate were included in the study. Head nurses, nurse managers, interns, and nurses on leave were excluded from participation. Ethical approval was obtained from the Department of Nursing, The Superior University before the initiation of the research study.

Data Collection Procedure

Data were collected using an adopted structured questionnaire consisting of three sections: demographic characteristics, nurses' knowledge regarding low-flow oxygen therapy and humidification, and nurses' practices regarding oxygen administration. Before collecting data, permission was obtained from the concerned hospital administration and ethical committee. The purpose and objectives of the study were clearly explained to all participants. Written informed consent was obtained from each nurse before participation. The questionnaire was distributed personally by the researcher among eligible nurses working in emergency units, ICU, and wards. Participants completed the questionnaires individually under the supervision of the researcher to minimize misunderstanding and response bias. The completed

questionnaires were collected immediately after completion and stored securely to ensure confidentiality and anonymity of the participants.

Data Analysis Procedure

The collected data were analyzed using the Statistical Package for Social Sciences (SPSS) version 23. All questionnaires were checked for completeness, coded, and entered into the software for analysis. Descriptive statistics including frequencies, percentages, means, and standard deviations were used to summarize demographic variables and responses related to nurses' knowledge and practices. The analyzed data were presented in the form of tables, charts, and graphs to facilitate interpretation and understanding of the study findings.

Results

Demographic Analysis

Table 1 presents the demographic profile of the participants included in the study. The majority of nurses (56.4%) were above 36 years of age, indicating that most participants were mature and experienced healthcare professionals. Female nurses represented the largest proportion of the sample (94.7%), showing that nursing remains a predominantly female profession in the selected hospital setting. Most participants were married (86.5%), while only 13.5% were unmarried. Regarding educational qualifications, more than half of the nurses (56.4%) held a BSN Post RN degree, followed by diploma holders (38.3%) and BSN Generic graduates (5.3%). In terms of formal training, 58.6% of nurses had received oxygen therapy training, whereas 41.4% had not attended any formal training program related to oxygen administration.

Table 4.1 Demographic Characteristics of Participants (n = 133)

Variables	Frequency (F)	Percentage (%)
Age		
22–26 years	26	19.5
27–31 years	11	8.3
32–36 years	21	15.8
Above 36 years	75	56.4
Gender		
Male	7	5.3
Female	126	94.7
Marital Status		
Married	115	86.5
Unmarried	18	13.5
Qualification		
Diploma in General Nursing	51	38.3
BSN (Post RN)	75	56.4
BSN Generic	7	5.3

Formal Training on Oxygen Therapy		
Yes	78	58.6
No	55	41.4

Figure 1 illustrates the overall knowledge level of nurses regarding low-flow oxygen therapy and humidification. More than half of the participants (54.1%) were categorized as very familiar with oxygen therapy concepts and humidification practices, indicating satisfactory theoretical understanding among nurses. About 34.6% demonstrated moderate familiarity, reflecting partial understanding of oxygen therapy guidelines and procedures. A smaller proportion (11.3%) reported not being familiar with important aspects of oxygen administration and humidification. These findings suggest that although most nurses possessed adequate knowledge, there were still gaps in understanding among some participants that may affect the safe delivery of oxygen therapy in clinical practice.

Figure 1: Knowledge of Nurses Regarding Low-Flow Oxygen Therapy and Humidification

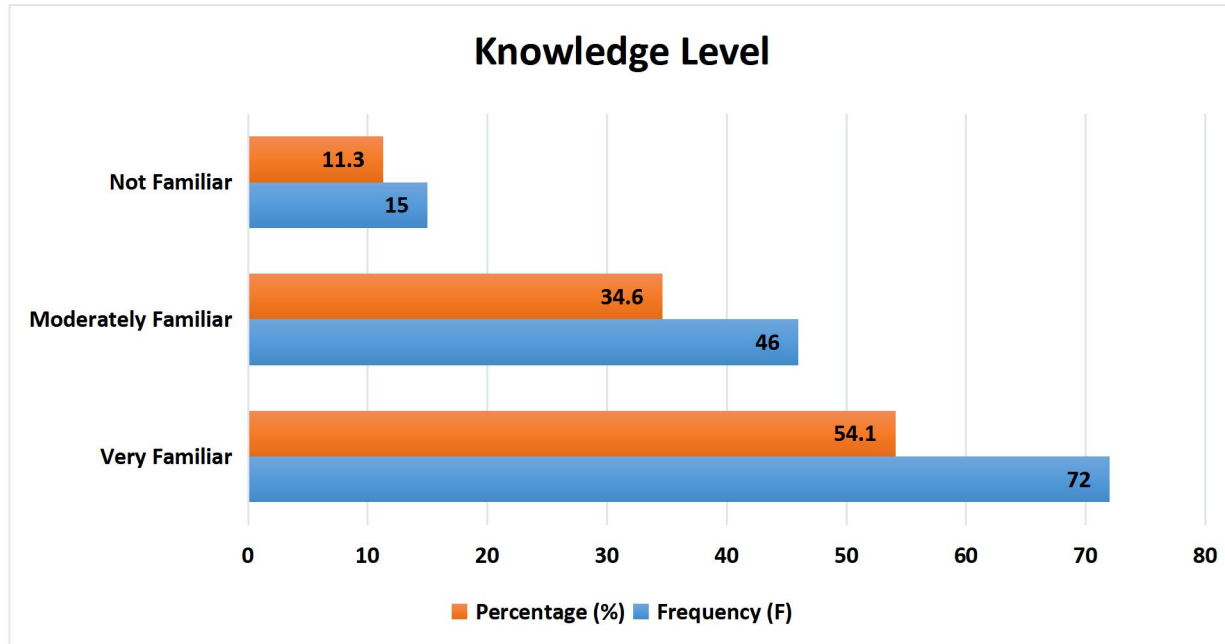


Figure 2 shows the practice levels of nurses regarding low-flow oxygen therapy and humidification techniques. Only 33.1% of nurses reported that they always followed recommended oxygen therapy practices during patient care. Around 15.8% stated that they often followed proper practices, while 27.8% reported performing these practices only sometimes. Additionally, 11.3% practiced them occasionally and 12.0% reported never consistently applying standard procedures. The findings indicate variability in clinical practice among nurses. Although some participants demonstrated adherence to oxygen therapy protocols, a considerable proportion lacked consistency in implementing evidence-based oxygen administration and humidification practices.

Figure 2: Practice of Nurses Regarding Low-Flow Oxygen Therapy and Humidification

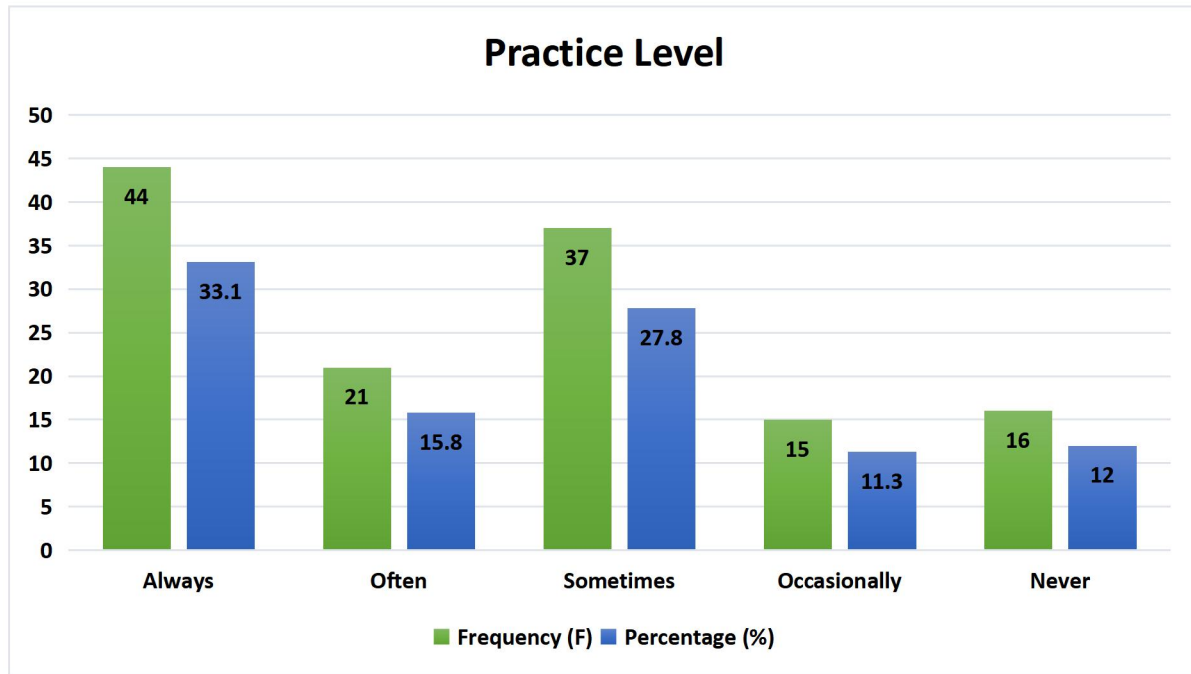


Table 2 presents the comparison between nurses' knowledge and practice scores regarding low-flow oxygen therapy and humidification. The mean knowledge score (3.42 ± 0.71) was higher than the mean practice score (3.11 ± 0.82), indicating that nurses possessed better theoretical knowledge compared to their practical implementation in clinical settings. The higher standard deviation in practice scores reflects inconsistency in the performance of oxygen therapy-related procedures among nurses. These findings suggest that adequate knowledge alone may not guarantee appropriate clinical practice and highlight the need for regular practical training sessions, workshops, and competency-based educational programs to improve nurses' performance regarding oxygen therapy and humidification.

Table 2 Relationship Between Nurses' Knowledge and Practice Regarding Low-Flow Oxygen Therapy

Variable	Mean	Standard Deviation
Knowledge Score	3.42	0.71
Practice Score	3.11	0.82

Discussion

The findings of this study indicate that staff nurses at a tertiary care hospital possess a generally good level of knowledge regarding low-flow oxygen therapy and humidification. The mean knowledge score of 20.21 out of 24 reflects a high level of understanding among participants, particularly in areas such as oxygen delivery systems, nasal cannula use, and indications for humidification. Similar results were reported in a study conducted in a tertiary hospital in Guangdong Province, where nurses achieved a knowledge score of 21.6 out of 25, demonstrating strong awareness of oxygen therapy principles (Ford & Robertson, 2021). High knowledge levels were also reported in another study where nurses showed acceptable understanding of oxygen flow rates, humidification needs, and oxygen saturation monitoring (Jacobs et al., 2020). These similarities suggest that nursing knowledge regarding oxygen therapy remains relatively strong across different healthcare settings.

A study conducted in the United States further supports these findings, where nurses demonstrated strong baseline knowledge of oxygen therapy principles with an average score of 35.8 out of 41 (Desalu et al., 2019). Competence was linked to routine clinical exposure and experience in respiratory care settings. Comparable results were observed in Japan, where nurses showed strong theoretical understanding of oxygen administration, humidification requirements, and oxygen safety limits (Notsu et al., 2024). Japanese hospitals demonstrated structured clinical guidelines that strengthened

knowledge and decision-making in oxygen therapy practices. These findings align with the current study and suggest that consistent clinical exposure and standardized guidelines contribute significantly to knowledge development among nurses in different regions.

The current study revealed poor practice levels among nurses regarding low-flow oxygen therapy and humidification, with an average practice score of 18.85 out of 40. Only a small proportion of nurses consistently performed essential practices such as oxygen saturation monitoring and patient education on humidification. Similar findings were reported in a study where nurses demonstrated adequate knowledge but failed to translate it into clinical practice (Tang et al., 2024). This gap between knowledge and practice was also observed in another study where nurses showed uncertainty regarding correct humidification procedures during oxygen therapy despite routine exposure to oxygen administration (Zhao et al., 2025). These results indicate that knowledge alone does not ensure proper clinical performance in oxygen therapy.

Findings from the United Kingdom further support the inconsistency in practice related to oxygen humidification. A study reported widespread use of low-flow oxygen therapy, yet humidification practices remained inconsistent due to variations in hospital protocols and lack of standardized guidelines (IRADUKUNDA, 2022). Similar concerns were identified in North American literature, where outdated practices such as the use of cold bubble humidifiers were still observed among nurses despite evidence of limited effectiveness and increased infection risk (Uwineza Didi, 2017). These findings reflect ongoing gaps in evidence-based practice and reinforce the results of the current study where inconsistent oxygen therapy practices were observed among nurses.

The discrepancy between knowledge and practice observed in the present study is consistent with findings from other international studies. A study conducted in Riyadh reported that nurses demonstrated good theoretical knowledge of oxygen therapy, while humidification practices remained poorly implemented due to limited training and absence of standardized protocols (Abohadida et al., 2025). Similar findings were reported in China, where nurses showed moderate knowledge levels but significantly lower practice scores in humidification during low-flow oxygen therapy (Zhai et al., 2025). These findings highlight that clinical performance is influenced by institutional support, availability of guidelines, and hands-on training rather than knowledge alone.

Research conducted in the United States also demonstrated a gap between knowledge and practice, where only 54% of nurses adhered to humidification protocols despite having an average knowledge score of 78% (Gottlieb et al., 2022). Barriers included lack of updated training and unclear clinical guidelines. A study from Japan also reported that nurses often failed to apply theoretical knowledge in practice due to reliance on habitual techniques and insufficient practical reinforcement (Pratt, 2022). These findings are consistent with the current study, indicating that even in well-resourced healthcare systems, translation of knowledge into practice remains a challenge.

The overall comparison of findings indicates that nurses in the current study possess adequate theoretical knowledge but demonstrate inadequate clinical practice regarding low-flow oxygen therapy and humidification. Similar patterns are reported across multiple international studies, suggesting a global issue in nursing practice rather than a localized problem. Deficiencies in training, lack of standardized protocols, and insufficient supervision are common contributing factors. The findings emphasize the need for continuous professional development programs, clinical refresher courses, and

implementation of evidence-based guidelines to improve oxygen therapy practices and ensure patient safety across healthcare settings.

Conclusion

In conclusion, the study reveals that staff nurses at a tertiary care hospital in Lahore possess a generally good level of knowledge regarding low-flow oxygen therapy and humidification, particularly in relation to oxygen delivery systems, appropriate device use, and basic humidification principles. However, their clinical practice does not consistently reflect this knowledge, as many nurses reported irregular implementation of essential procedures such as oxygen saturation monitoring, correct device adjustment, and patient education on humidification. The findings highlight a clear gap between theoretical understanding and practical application, suggesting that knowledge alone is not sufficient to ensure safe and effective oxygen therapy delivery. This gap may be associated with inadequate hands-on training, lack of standardized clinical protocols, and limited opportunities for continuous professional development. Strengthening structured training programs, reinforcing evidence-based guidelines, and improving supervision in clinical settings are necessary to enhance nursing performance. Addressing these issues will ultimately improve patient safety, optimize oxygen therapy outcomes, and ensure more consistent and effective use of low-flow oxygen therapy and humidification in clinical practice.

Recommendations

1. Regular in-service training, workshops, and refresher courses should be arranged for staff nurses to improve their knowledge and hands-on skills regarding low-flow oxygen therapy and humidification techniques.

2. Standardized hospital protocols and evidence-based guidelines should be developed and strictly implemented to ensure uniform practice in oxygen administration and humidification across all clinical units.
3. Continuous supervision and clinical audits should be conducted by senior nursing staff to monitor adherence to oxygen therapy standards and identify areas requiring improvement.
4. Practical demonstrations and simulation-based training sessions should be introduced to strengthen the clinical competence of nurses in oxygen therapy management and improve patient safety outcomes.
5. Further research studies should be conducted on a larger scale in different hospitals and regions to explore barriers affecting nursing practice and to develop strategies for improving the quality of respiratory care services.

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