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RESEARCH ARTICLE (ORIGINAL)

Knowledge about oxygen therapy in final-year nursing students

Conhecimento sobre oxigenoterapia em estudantes de enfermagem do último ano
Conocimiento de la oxigenoterapia entre los estudiantes de último curso de enfermería

Thai Thi Minh Hoang [1]
https://orcid.org/0000-0002-5614-5124

La Thi Vu [1]
https://orcid.org/0009-0009-7635-6461

Anh Thi Lan MAI [1]
https://orcid.org/0000-0003-2487-7766

Quan Trong Dao [2]
https://orcid.org/0009-0006-4752-0451

[1] Nam Dinh University of Nursing, Faculty of Nursing and Midwifery, Nam Dinh, Vietnam

[2] Thai Nguyen University of Medicine and Pharmacy, Faculty of Nursing, Thai Nguyen, Vietnam

Corresponding author
Quan Trong Dao
E-mail: daotrongquan@tnmc.edu.vn

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Abstract
Background: Knowledge of oxygen therapy is crucial for nurses to recognize early risk factors and prevent complications, thereby enhancing treatment efficiency.
Objective: This study aimed to describe the knowledge about oxygen therapy in final-year nursing students at Nam Dinh University of Nursing.
Methodology: A cross-sectional descriptive study was conducted with 236 final-year undergraduate nursing students. Data were collected using a self-administered questionnaire.
Results: The mean score for students' general knowledge was 6.73 ± 1.43 out of 10. The lowest mean score was for knowledge about weaning and discontinuing oxygen therapy (3.79 ± 1.89) and knowledge about oxygen delivery devices (5.34 ± 2.77). Scores for recognizing signs of hypoxemia and monitoring and evaluating the effectiveness of oxygen therapy were 8.88, 6.37, and 8.38, respectively.
Conclusion: Students' knowledge about oxygen therapy is average, with gaps in areas such as weaning and discontinuing oxygen therapy and oxygen delivery devices. Greater focus on these topics in pre-clinical and clinical education is advised to improve patient care, oxygen use, and reduce complications.

Keywords: knowledge; nursing student; oxygen inhalation therapy; monitoring; patient safety; Vietnam

Resumo
Enquadramento: O conhecimento da oxigenoterapia é crucial para que os enfermeiros reconheçam precocemente os fatores de risco e previnam complicações, aumentando assim a eficácia do tratamento.
Objetivo: Este estudo teve como objetivo descrever o conhecimento sobre oxigenoterapia em estudantes finalistas de enfermagem da Universidade de Enfermagem Nam Dinh**.**
Metodologia: Foi realizado um estudo descritivo transversal com 236 estudantes finalistas da licenciatura em enfermagem. Os dados foram recolhidos por meio de um questionário autoadministrado.
Resultados: A pontuação média para conhecimento geral dos estudantes foi de 6,73 ± 1,43 em 10. A menor pontuação média foi para conhecimento sobre redução da dosagem e interrupção da oxigenoterapia (3,79 ± 1,89) e conhecimento sobre dispositivos de administração de oxigénio (5,34 ± 2,77). As pontuações para a identificação de sinais de hipoxemia, monitorização e avaliação da eficácia da oxigenoterapia foram 8,88, 6,37 e 8,38, respetivamente.
Conclusão: O conhecimento dos estudantes sobre oxigenoterapia é moderado, com lacunas em áreas como redução da dosagem e interrupção da oxigenoterapia e dispositivos de administração de oxigénio. Recomenda-se um maior foco nestes tópicos na educação pré-clínica e clínica uma vez que pode levar a um melhor atendimento ao doente, a uma utilização mais eficiente do oxigénio e a menos complicações na prática clínica.

Palavras-chave: conhecimentos de oxigenoterapia; estudante de enfermagem; educação clínica; oxigenoterapia; monitorização; segurança do doente; Vietname

Resumen
Marco contextual: El conocimiento de la oxigenoterapia es crucial para que el personal de enfermería reconozca precozmente los factores de riesgo y prevenga las complicaciones, lo cual aumenta la eficacia del tratamiento.
Objetivo: El objetivo de este estudio fue describir el conocimiento sobre oxigenoterapia de los estudiantes de último curso de Enfermería de la Universidad de Enfermería de Nam Dinh**.**
Metodología: Se llevó a cabo un estudio descriptivo transversal con 236 estudiantes de último curso del Grado en Enfermería. Los datos se recogieron mediante un cuestionario elaborado por ellos mismos.
Resultados: La puntuación media del conocimiento general de los alumnos fue de 6,73 ± 1,43 en 10. La puntuación media más baja correspondió al conocimiento sobre la retirada y la interrupción de la oxigenoterapia (3,79 ± 1,89), y el conocimiento de los dispositivos de oxígeno suplementario (5,34 ± 2,77). Las puntuaciones en reconocimiento de signos de hipoxia, monitorización y evaluación de la eficacia de la oxigenoterapia fueron de 8,88, 6,37 y 8,38, respectivamente.
Conclusión: El conocimiento de los estudiantes sobre oxigenoterapia es medio, con lagunas en áreas como la retirada, la interrupción y la comprensión de los dispositivos de oxígeno. Se recomienda una mayor atención a estos temas en la formación preclínica y clínica, ya que puede conllevar una mejor atención al paciente, un uso más eficiente del oxígeno y menos complicaciones en la práctica clínica.

Palabras clave: conocimiento sobre oxigenoterapia; estudiante de enfermería; educación clínica; oxigenoterapia; monitorización; seguridad del paciente; Vietnam

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Introduction

Oxygen therapy is a critical intervention prescribed to prevent the risk of death or damage to target organs due to insufficient oxygen levels. However, prolonged use of oxygen with high fractions of inspired oxygen (FiO2; > 50%) for more than 24 hours can lead to serious complications, including oxygeb toxicity, absorption atelectasis, hypoventilation, retinopathy of prematurity, respiratory alkalosis, and superinfection (Cooper et al., 2023; O'Driscoll et al., 2017).

As future healthcare providers, final-year nursing students must acquire adequate knowledge about oxygen therapy to meet the professional standards expected in university-level nursing practice. This study aims to examine the knowledge about oxygen therapy in final-year nursing students at Nam Dinh University of Nursing. The findings could provide valuable insights into curriculum modifications, teaching methodologies, and assessment strategies.

Background

Oxygen therapy is a critical, life-saving intervention for patients with respiratory and cardiovascular conditions, ensuring that the body receives adequate oxygen to maintain essential physiological functions. A comprehensive understanding of oxygen therapy encompasses several key concepts, including recognizing hypoxemia, using various oxygen delivery devices, preventing complications associated with oxygen therapy, and monitoring and evaluating its effectiveness. Additionally, knowledge of guidelines for appropriately reducing dosage and discontinuing oxygen therapy is vital for ensuring patient safety and optimal outcomes.

This knowledge is essential for nurses to recognize early risk factors and prevent complications, thereby improving treatment outcomes (Ernstmeyer & Christmanet, 2021). Research indicates that nurses with good knowledge about oxygen therapy are 12 times more likely to deliver effective patient care than those with limited knowledge (Zeleke & Kefale, 2021). Despite this, evidence shows that many nurses lack sufficient knowledge about oxygen therapy (Adipa et al., 2015; Nabwire et al., 2018). Contributing factors to this knowledge gap include outdated information, lack of clinical guidelines, and work overload (Arslan et al., 2017; Nabwire et al., 2018). Addressing these gaps in knowledge is crucial for enhancing nursing practice and improving the quality of patient care. The British Thoracic Society Guideline, which provides current and relevant recommendations for oxygen use in healthcare and emergency settings (O'Driscoll et al., 2017), was the most current and relevant source for this study due to its evidence-based recommendations on the effective use of oxygen therapy in various clinical contexts. By aligning nursing education and practice with these guidelines, we can ensure that nursing students are adequately prepared to implement oxygen therapy effectively, thereby enhancing patient safety and care quality.

Research question

What is the level of knowledge about oxygen therapy in final-year nursing students at Nam Dinh University of Nursing?

Methodology

Study design and participants

The inclusion criteria included (1) full-time students enrolled in the fourth year of the undergraduate degree in nursing; (2) completing clinical nursing courses with a grade point average (GPA) of D or higher; (3) students who are eligible to have graduation internships in hospitals. The exclusion criteria were (1) students who participated in the pilot test of the questionnaire of this study and (2) who refused to participate in the study.

A cross-sectional descriptive study was conducted at Nam Dinh University of Nursing, Vietnam, from December 2021 to December 2022. The sample comprised 383 participants.

A convenience sampling method was employed to select participants for the study. This process began with the selection of individuals who met the inclusion criteria, as identified by academic advisors. All clinical practice opportunities related to oxygen therapy were considered for inclusion. The advisors introduced the researchers to the students, outlining the aims and significance of the study. Those who agreed to participate were asked to sign an informed consent form and were subsequently invited to complete a self-administered online questionnaire, which took approximately 15 minutes to finish. A total of 383 requests were sent out, resulting in 236 responses.

Measurements

The questionnaire was developed based on the British Thoracic Society Guideline which guides oxygen use in health care and emergency settings (O'Driscoll et al., 2017). The questionnaire consists of two parts: students' general information and students' knowledge about oxygen therapy. The questionnaire for assessing students' knowledge was designed and evaluated by a research team for its validity with the S-CVI index of 0.75 and the reliability index by the test and retest method with the correlation index $r = 0.818$. The questionnaire included 60 questions across six dimensions, including Basic knowledge (15 items), Knowledge about applicable cases (10 items), Knowledge about recognizing signs of hypoxemia (5 items), Knowledge about oxygen delivery devices (10 items), Knowledge about preventing complications (10 items), Knowledge about monitoring and evaluating the effectiveness of oxygen therapy (5 items), Knowledge about reducing dosage and discontinuing oxygen therapy (5 items). Each question with the correct answer got 1 point and/or with a wrong or do-not-know answer got 0 points. The knowledge score of each area and the total knowledge score were changed into a 10-point scale and classified based on Bloom's cut-off point method (Adeniyi et al., 2021; Table 1).

Table 1

Classification of the knowledge

Score level	Classification of the knowledge
From 8.0 to 10 points (from 80% to 100% of total score)	High
From 6.0 to 7.9 points (from 60% to 79% of the total score)	Moderate
Below 6.0 points (less than 60% of the total score)	Poor

Data collection
Data was collected through a self-administered questionnaire.

Ethical considerations
The study was approved by the university's scientific and human research ethics committee (IRB-VN01012: No. 06/GCN-HĐĐ, date 28/2/2022).

Data analysis
Frequencies, percentages, means, and standard deviations were used to describe participants' characteristics. The *t*-test and ANOVA were used to compare two means and more than two means when necessary. Data were analyzed using IBM SPSS Statistics software, version 25.0, and statistical significance was set at a *p*-value < 0.05.

Results

In a total of 236 responses, there were no missing data.

Knowledge about recognizing signs of hypoxemia
All participants correctly answered tachycardia and shortness of breath as signs of hypoxemia (Table 2). About 92.4% of the students correctly answered that hypoxemia causes irritability; only 79.2% of the students recognized that PaO_2 < 60mmHg is defined as hypoxemia (Table 2).

Table 2

Correct knowledge about recognizing signs of hypoxemia (n = 236)

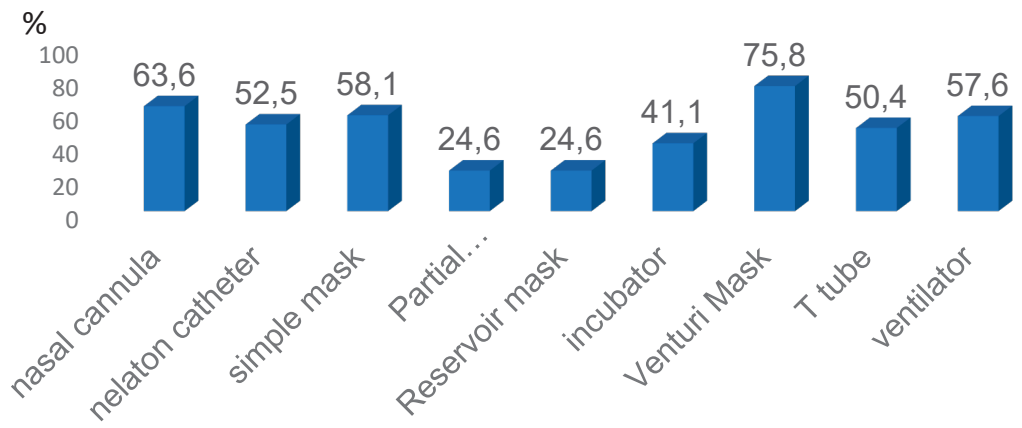
Knowledge about recognizing signs of hypoxemia	*n*	%
Decreased blood oxygen causes rapid heart rate	236	100
Shortness of breath is a sign of hypoxemia	236	100
Decreased blood oxygen causes irritability	182	92.4
PaO2 < 60 mmHg is defined as hypoxemia	**187**	**79.2**
SpO2 < 90% is defined as hypoxemia	**231**	**97.9**

Note. *n* = Sample; % = Percentage.

Knowledge about oxygen delivery devices
The proportion of correct knowledge was 63.6% for nasal cannulae, 52.5% for nelaton catheter, 58.1% for simple face mask, 24.6% for partial rebreather mask, 24.6% for reservoir mask, 41.1% for incubator, 75.8% for Venturi mask, 50.4% for T-tube, 57.6% for ventilator (Figure 1).

Figure 1

Correct knowledge about oxygen delivery devices (n = 236)



Knowledge about preventing complications associated with oxygen therapy

The students' responses to questions related to knowledge about preventing complications range from 27.1% to 71.6%. The most common correct answer was superinfection with 71.6%. The least common correct answer was respiratory alkalosis (27.1%). The results are shown in Table 3.

Table 3

Correct knowledge about preventing complications associated with oxygen therapy (n = 236)

Knowledge about preventing complications	***n***	**%**
Oxygen toxicity	108	45.8
Absorbtion atelectasis	140	59.3
CO2 inhalation	**93**	**39.4**
Reduced ventilation	154	65.3
Retinopathy of prematurity	213	90.3
Respiratory alkalosis	**64**	**27.1**
Superinfection	169	71.6

Note. n = Sample; % = Percentage.

Knowledge about reducing dosage and discontinuing oxygen therapy

The students' correct knowledge about reducing dosage and discontinuing oxygen therapy was 27.5% and 16.9%, respectively (Table 4).

Table 4

Correct knowledge about reducing dosage and discontinuing oxygen therapy (n = 236)

Knowledge about	***n***	**%**
Reducing dosage	65	27.5
Discontinuing oxygen therapy	40	16.9

Note. n = Sample; % = Percentage.

Final-year nursing students' general knowledge about oxygen therapy

The mean score of students' general knowledge was 6.73 ± 1.43 points. Knowledge about reducing dosage and discontinuing oxygen therapy had the lowest mean score of 3.79 ± 1.89 points. The highest mean score was in knowledge about recognizing signs of hypoxemia. The detailed information is presented in Table 5.

Table 5

Final-year nursing students' general knowledge about oxygen therapy (n = 236)

Knowledge about	Mean ± *SD*	Classification
Recognizing signs of hypoxemia	8.88 ± 1.78	High
Oxygen delivery devices	5.34 ± 2.77	Poor
Complications of oxygen therapy	6.37 ± 2.84	Moderate
Monitoring and evaluating the effectiveness of oxygen therapy	8.38 ± 1.53	High
Reducing dosage and discontinuing oxygen therapy	3.79 ± 1.89	Poor
General knowledge	6.73 ± 1.43	Moderate

Note. *SD* = Standard deviation.

Factors related to students' knowledge about oxygen therapy

Female students had the mean score of general knowledge (6.87 ± 1.33 points/10 points) higher than male students (5.57 ± 1.69 points/10 points). The difference was statistically significant with $p < 0.05$. Students who had ever performed the technique of administering oxygen therapy to patients had a higher average score of knowledge (6.88 ± 1.37 points/10 points) than those who did never (5.00 ± 0. 82 points/10 points). The difference was statistically significant with $p < 0.05$. Students with higher GPAs had better knowledge ($p < 0,05$). There was no difference in knowledge scores between students living with friends or living alone/with relatives. The factors related to students' knowledge about oxygen therapy are presented in Table 6.

Table 6

Relationship between students' general information and students' knowledge (n = 236)

Variable		Knowledge points (mean ± *SD*)	test	*p*-value
Gender	Male	5.57 ± 1.69	$t = 4.527$	.001
	Female	6.87 ± 1.33		
Grade point average	A	8.02 ± 1,02	$F = 3.426$	.003
	B	7.35 ± 1.31		
	C	6.45 ± 1,06		
Ever performed oxygen therapy in clinical practice	Ever	6.88 ± 1.37	$t = 5.844$	.000
	Never	5.00 ± 0.82		
Living status	Living with friends	6.89 ± 1.62	$t = 13.241$	.07

Note. *SD* = Standard deviation.

Discussion

Current status of final-year nursing students' knowledge about oxygen therapy

The results showed that a high percentage of the final-year nursing students had correct knowledge of the clinical signs of hypoxemia such as tachycardia, shortness of breath, and irritability. Additionally, students responded correctly about the SpO_2 value to determine the level of hypoxemia. Such good results might be because this group of nursing students was fully trained in clinical symptoms and monitoring patients with signs of hypoxemia as a severe complication of COVID-19 infection.

In order to maximize the effectiveness of different oxygen delivery devices as well as to prevent complications due to improper use of equipment, nurses should have adequate knowledge of the proper use of oxygen delivery equipment and the appropriate flow rates for each type of equipment. The results showed that the percentage of students with correct knowledge of using supplemental oxygen devices was not high. In particular, the correct knowledge of using partial rebreather masks, reservoir masks, and incubators had the lowest rate of 24.6%; 24.6%; and 41.1% respectively. Other studies also showed that clinical nurses also had poor knowledge of oxygen delivery equipment and appropriate airflow rates (Desalu et al., 2022; Hassanzad et al., 2022).

Although oxygen therapy is commonly used in clinical practice, if used incorrectly, it can cause many complications for patients. The study showed that the percentage

of students with correct knowledge about preventing complications associated with oxygen therapy was not high. Only 27.1% of the students knew that administering patients' oxygen with high concentration (FiO_2) for a long period could cause respiratory alkalosis for the patient; while 39.4% of the students knew that if low-flow oxygen was administered to patients with a mask, the patient was at risk of re-breathing CO_2. Aloushan et al. (2019) indicated that there were gaps in the knowledge, attitude, and practice of emergency nurses, especially in the timing of using oxygen therapy and monitoring complications associated with oxygen therapy (Aloushan et al., 2019). Moreover, the results showed that students had low levels of correct knowledge about reducing dosage and discontinuing oxygen therapy (27.5% and 16.9%). This is one of the contents that relevant clinical modules should pay attention to and emphasize to help students have more complete knowledge to improve their clinical practice. Final-year nursing students' knowledge about oxygen therapy is average with a mean score of 6.73 ± 1.43 points/10 points, in which the lowest mean score belonged to knowledge about reducing dosage and discontinuing oxygen therapy (3.79 ± 1.89 points/10 points); followed by knowledge about oxygen delivery devices (5.34 ± 2.77 points/10 points). Knowledge about preventing complications had a mean score of 6.37 ± 2.84 points/10 points. Academic motivation helps students realize the importance of learning for their own career development (Demírel & Kazan, 2020; Tran et al., 2019). In addition, the ability to remember also depends on individual consciousness and the impact of frequent repetition (Al et al., 2019; Tran et al., 2019). It can be concluded that students' knowledge still has some shortcomings, likely due to a lack of clear recognition of their learning motivations and reliance on conscious effort for memory retention, which is influenced by frequent repetition. Additionally, students may not have fully identified their motivation for learning, which is essential for helping them understand the importance of their education and perceive it as a voluntary pursuit aligned with their goals. Therefore, related clinical courses should incorporate knowledge reviews, particularly emphasizing nursing students' care plans tailored to specific patient cases in clinical settings.

Factors related to knowledge and practice of oxygen therapy of final-year nursing students

The results showed that female students had a higher mean score of general knowledge (6.87 ± 1.33 points/10 points) than male students (5.57 ± 1.69 points/10 points). The difference was statistically significant with $p < 0.05$. The difference may be due to the disparity in the distribution of gender in the research subjects with 89% of the students being female. The research results were similar to those of Al et al. (2019), who found that there was a statistically significant difference in knowledge between female nursing students (26.47 ± 3.10) and male nursing students (23.42 ± 4.03; Al et al., 2019).

A survey of students' GPAs before graduation indicated that the group of students with high GPAs had higher scores of knowledge about oxygen therapy. The difference was statistically significant with $p < 0.05$. Practice demonstrated that when students integrated the knowledge of fundamental modules with clinical knowledge and applied it well in clinical patient care practice, they would accumulate a lot of experience to improve their knowledge about oxygen therapy.

When asking about students' clinical experiences with oxygen therapy practice, the research results illustrated that students who had ever performed the technique for oxygenating patients had a higher mean score of general knowledge (6.88 ± 1.37 points/10 points) than those who had never performed the technique (5.00 ± 0.82 points/10 points). The difference was statistically significant with $p < 0.05$. According to Bloom's level of knowledge classification, students' knowledge will be classified from simple to complex, from remembering, understanding, applying, analyzing, evaluating, and creating. Therefore, if students accumulate a lot of experience from clinical practice, it might help them remember knowledge longer. There was no difference in knowledge about oxygen therapy among students living with friends and students living alone/ with relatives ($p > 0.05$). Practice indicates that if students know how to share knowledge during their studying, it is also a good way to help them improve knowledge and good practice skills. A study of knowledge about oxygen therapy by Hassanzad et al. (2022) reported that information and education through different information channels could affect nurses' knowledge level about oxygen therapy (Hassanzad et al., 2022). Although the study did not find a difference in the score of knowledge regarding students' living status, it was also hoped that peer-to-peer knowledge sharing outside of the full-time training program could improve students' knowledge more.

Limitations of the study

The study on oxygen therapy knowledge in final-year nursing students at Nam Dinh University of Nursing has several limitations, including a potential sampling bias due to the specific inclusion criteria and a non-response rate, which could affect the representativeness of the findings. Self-reported data may also introduce response bias, and the cross-sectional design limits the ability to assess changes over time or causal relationships. To enhance the study's robustness, future research should include a larger, multicenter study and a more diverse sample of nursing students and consider longitudinal designs to track knowledge development. Additionally, incorporating practical assessments alongside theoretical knowledge could provide a more comprehensive evaluation of students' competency in oxygen therapy. Exploring factors such as clinical exposure and curriculum impact on knowledge could offer further insights into educational strategies for improving nursing students' proficiency in oxygen therapy.

Conclusion

The knowledge about oxygen therapy in full-time students enrolled in the final year of the undergraduate degree in

nursing at Nam Dinh University of Nursing was found to be average, with a mean score of 6.73 ± 1.43 out of 10. Specifically, knowledge about weaning and discontinuing oxygen therapy was the lowest in the evaluated areas. Female students achieved a significantly higher mean score in general knowledge compared to their male counterparts, and students who had performed oxygenation techniques on clinical patients had a significantly higher mean score than those who had not.

Additional oxygen therapy training should be provided alongside the main curriculum to enhance student learning. Inviting clinical experts to share their knowledge would be particularly beneficial. Furthermore, greater emphasis is needed on students' understanding of arterial blood gas indices, such as PaO2, PaCO2, and blood pH, as well as knowledge about oxygen delivery devices—especially high-flow oxygen systems—and complications such as CO2 rebreathing and respiratory alkalosis. Additionally, students should be educated on monitoring and evaluating the effectiveness of oxygen therapy through paraclinical indices and the proper procedures for reducing dosage and discontinuing therapy.

Finally, fostering an active learning attitude is essential, especially in clinical practice, to ensure that students can apply their knowledge and develop the proficient skills necessary to become competent nurses.

Author contributions

Conceptualization: Hoang, T.M.
Data curation: Dao, V. Q., Vu, T. L.
Formal analysis: dao, V. Q.
Methodology: Hoang, T. M.
Supervision: Mai, A. T
Validation: Hoang, T. M.
Writing - original draft: Vu, T. L., Mai, T. L.
Writing - review & editing: Hoang, T. M.

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References

Adeniyi, B. O., Akinwalere, O. O., Ekwughe, F. C., Ogunmodede, A. F., Kareem, A. O., Olakanye, O. D., Erhabor, G. E., & Abejegah, C. (2021). Assessment of knowledge and practice of oxygen therapy among doctors and nurses: A survey from Ondo State, Southwest Nigeria. *Journal of the Pan African Thoracic Society*, *2*(3), 161-166. https://doi.org.10.25259/JPATS_4_2021

Adipa, F. E., Aziato, L., & Zakariah, A. N. (2015). Qualitative exploration of nurses' perspectives on clinical oxygen administration in Ghana. *International Journal of Africa Nursing Sciences*, *2*, 42-46. https://doi.org/10.1016/j.ijans.2015.03.002

Al, N., Aydin, A. I., Atak, M., Akca, D., Ozyazicioglu, N., & Alkan, T. (2019). Determination of the knowledge levels of nursing students on oxygen administration in newborn intensive care units. *International Journal of Caring Sciences*, *12*(1), 280-285. https://internationaljournalofcaringsciences.org/docs/31_nevin_12_1_1.pdf

Aloushan, A. F., Almoaiqel, F. A., Alghamdi, R. N., Alnahari, F. I., Aldosari, A. F., Masud, N., & Aljerian, N. A. (2019). Assessment of knowledge, attitude and practice regarding oxygen therapy at emergency departments in Riyadh in 2017: A cross-sectional study. *World Journal of Emergency Medicine*, *10*(2), 88-93. https://doi.org/10.5847/wjem.j.1920-8642.2019.02.004

Arslan, F. T., Ozkan, S., Ak, B., & Muslu, G. K. (2017). Neonatal intensive care nurses' opinion on oxygen therapy: A survey conducted in Turkey. *Journal of Contemporary Medicine*, *7*(2), 184-192. https://doi.org.10.16899/gopctd.326667

Cooper, J. S., Phuyal, P., & Shah, N. (2023). Oxygen toxicity. *StatPearls.* https://www.ncbi.nlm.nih.gov/books/NBK430743/

Demírel, H., & Kazan, E. E. (2020). Knowledge levels of nurses about oxygen therapy in Turkey. *International Journal of Health Services Research and Policy*, *5*(1), 1-14. https://doi.org.10.33457/ijhsrp.700150

Desalu, O. O., Ojuawo, O. B., Adeoti, A. O., Oyedepo, O. O., Aladesanmi, A. O., Afolayan, O. J., Ibraheem, R. M., Suleiman, Z. A., & Opeyemi, C. M. (2022). Doctors' and nurses' knowledge and perceived barriers regarding acute oxygen therapy in a tertiary care hospital in Nigeria. *Advances in Medical Education and Practice*, *13*, 1535-1545. https://doi.org.10.2147/AMEP.S378533

Ernstmeyer, K., & Christman, E. (Eds.). (2021). *Nursing skills: Oxygen therapy* (Chap. 11). Chippewa Valley Technical College. https://www.ncbi.nlm.nih.gov/books/NBK593208/

Hassanzad, M., Ghaffaripour, H., Rekabi, M., Mirzendehdel, M., Sadati, E., Elahimehr, N., & Derakhshanfar, H. (2022). Nurses' knowledge regarding oxygen therapy; a cross-sectional study. *Archives of Academic Emergency Medicine*, *10*(1), e38. https://doi.org.10.22037/aaem.v10i1.1553

Nabwire, J., Namasopo, S., & Hawkes, M. (2018). Oxygen availability and nursing capacity for oxygen therapy in Ugandan paediatric wards. *Journal of tropical Pediatrics*, *64*(2), 97–103. https://doi.org/10.1093/tropej/fmx033

O'Driscoll, B., Howard, L., Earis, J., & Mak, V. (2017). British Thoracic Society Guideline for oxygen use in adults in healthcare and emergency settings. *BMJ Open Respiratory Research*, *4*(1), e000170. https://doi.org.10.1136/bmjresp-2016-000170

Tran, T. D., Le, T. T., Nguyen, T. H., & Thai, L. A. (2019). Learning motivation of full-time nursing students at Hai Phong University of Medicine and Pharmacy. *Journal of Nursing Science*, *2*(1), 96 - 104.

Zeleke, S., & Kefale, D. (2021). Nurses' supplemental oxygen therapy knowledge and practice in Debre Tabor General Hospital: A cross-sectional study. *Open Access Emergency Medicine*, *13*, 51-56. https://doi.org.10.2147/OAEM.S299139