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Training and Knowledge Status of Doctors and Nurses on Oxygen Therapy in a Level Three Hospital-Survey Study

Üçüncü Basamak Bir Hastanede Doktor ve Hemşirelerin Oksijen Tedavisi Konusundaki Eğitim ve Bilgi Durumu-Anket Çalışması

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ABSTRACT

Objective: Oxygen therapy (OT) is the administration of oxygen (O_2) at a concentration greater than that found in the atmosphere to prevent the symptoms of hypoxemia. The necessary knowledge, skills and attitudes of the staff while OT may affect the treatment outcomes. In our study, we aimed to determine the training and knowledge status of doctors and nurses working in our university hospital on OT.

Methods: The cross-sectional study was completed with 231 participants after ethics committee approval. Data were obtained by hand-completion of questionnaires consisting of 23 questions to volunteer. According to the correct answers given to the questions investigating the level of knowledge, scores >80% were classified as good knowledge level and <60% as poor knowledge level. p<0.05 was considered significant.

Results: The number of employees reached by the survey was 422 and 85% of nurses and 62% of doctors stated that they had knowledge of OT application. Twenty seven percent of nurses and 42% of doctors were using guidelines for OT. Eighty six percent of doctors and 90% of nurses felt that training for OT was necessary and the most common sources of information were school education. The rate of good knowledge was 9.7% among nurses and 14.3% among doctors (p=0.418). Regarding the expected clinical outcomes of OT, 71% of physicians and 49% of nurses had a good level of knowledge (p<0.001). Sixty four percent of physicians and 86% of nurses (p<0.001) had a poor level of knowledge about low-flow OT and 49% of physicians and 69% of nurses had a poor level of knowledge (p=0.004) about indications for short-term OT. Most of the participants (87.7%) had poor knowledge about O_2 toxicity.

Conclusion: It was concluded that the majority of healthcare professionals have insufficient knowledge in OT and comprehensive training programs are needed at regular intervals.

Keywords: Oxygen therapy, education, information, survey study

ÖZ

Amaç: Oksijen tedavisi (OT), hipokseminin belirtilerini önlemek amacıyla atmosferde bulunan konsantrasyonundan daha fazla yoğunlukta oksijen uygulanmasıdır. Terapötik O_2 uygulanırken çalışanların gerekli bilgi, beceri ve tutumları tedavi sonuçlarını etkileyebilmektedir. Çalışmamızda üniversite hastanemizde çalışan doktor ve hemşirelerin OT konusundaki eğitim ve bilgi durumlarını belirlemeyi amaçladık.

Yöntem: Kesitsel çalışma, etik kurul onayı sonrası 231 katılımcıyla tamamlandı. Veriler, gönüllülere 23 sorudan oluşan anket formlarının elden doldurulması yoluyla elde edildi. Bilgi düzeylerini araştıran sorulara verilen doğru yanıtlara göre puan >%80 ise iyi, <%60 ise zayıf bilgi düzeyi olarak sınıflandırıldı. p<0,05 anlamlı kabul edildi.

Bulgular: Anketin ulaştığı çalışan sayısı 422 olup hemşirelerin %85'i, doktorların %62'si OT uygulama bilgisi olduğunu belirtti. Hemşirelerin %27'si, doktorların %42'si OT için kılavuz kullanıyordu. Doktorların %86'sı ve hemşirelerin %90'ı OT için eğitiminin gerekli olduğunu düşünüyordu ve en yaygın bilgi kaynakları okul eğitimleriydi. Hemşirelerde iyi bilgi düzeyi oranı %9,7 iken, doktorlarda %14,3 idi (p=0,418). Oksijen tedavisinin beklenen klinik sonuçları konusunda ise doktorların %71'i, hemşirelerin %49'u iyi bilgi düzeyine sahiptiler (p<0,001). Düşük akımlı OT uygulama yolları konusunda doktorların %64'ü ve hemşirelerin %86'sı (p<0,001), kısa süreli OT endikasyonları konusunda da doktorların %49'u ve hemşirelerin %69'u zayıf bilgi düzeyine (p=0,004) sahiptiler. Oksijen toksisitesi konusunda ise katılımcıların çoğu (%87,7) zayıf bilgi düzeyine sahipti.

Sonuç: Sağlık çalışanlarının önemli bir kısmının OT uygulaması konusunda yeterli bilgiye sahip olmadığı ve düzenli aralıklarla kapsamlı eğitim programlarına ihtiyaç olduğu sonucuna varıldı.

Anahtar sözcükler: Oksijen tedavisi, eğitim, bilgi, anket çalışması

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INTRODUCTION

Oxygen therapy (OT) is the administration of oxygen (O_2) at a higher concentration than the concentration found in the surrounding atmosphere in order to prevent the signs and symptoms of hypoxemia (1). Oxygen, ike other medical drugs, is administered by healthcare professionals; when used at the appropriate time and in the required amount, it has an important role in saving the lives of many patients with heart and lung disease (2-5). Acute OT is usually initiated when tissue hypoxia is suspected in situations such as hypoxemia or respiratory distress, severe anemia-sepsis, and shock (6). Excessive O_2 administration is especially harmful in conditions associated with hypercapnic respiratory failure, such as chronic obstructive pulmonary disease (7). Improper application may result in prolonged hospital stay and increased risk of death (8). Hypoventilation, atelectasis and pulmonary O_2 toxicity are the main complications of OT (9). It is thought that hyperoxia may be associated with increased mortality in patients after cardiac arrest, stroke, and traumatic brain injury (10-12). In patients with suspected hypoxemia, initially peripheral O_2 saturation (SpO_2) evaluation, and in patients whose general condition is critical and SpO_2 cannot be measured, or hypercapnia is suspected, partial arterial O_2 and carbon dioxide pressure evaluation is recommended (9,13). The effectiveness of the treatment is evaluated by measuring SpO_2, monitoring the respiratory rate and closely monitoring the patient (9).

Different methods are used for OT; these are low flow systems (15< L min^{-1} flow rate) such as nasal cannula, simple O_2 mask, masks with reservoirs and high flow systems such as venturi mask and high flow nasal cannula (HFNC) (14).

It is necessary for healthcare professionals to have sufficient knowledge, conduct and skills regarding OT for quality patient care. Although there are studies on OT application methods in the literature, studies on the training and knowledge adequacy of practitioners in terms of OT applications are rare (9,13,15). In our study, it was aimed to determine the training and knowledge status of doctors and nurses working in our university hospital on OT and to contribute to the correct application of O_2 by raising awareness about O_2 applications.

MATERIALS and METHODS

Survey Form

Ethics approval was obtained from the Local Ethics Committee of University of Zonguldak Bülent Ecevit. Protocol No. 2022/22) and this study was realised between 1 January 2023 and 1 February 2023. The survey questions (23 questions), which were compiled from the studies on the subject, were read to 10 people who did not participate in the research in terms of comprehensibility (16,17). Our survey was pilot tested among anesthesia, emergency specialists and intensive care nurses in a level III training hospital. Before the survey was administered, changes were made to reduce the number of questions and increase the comprehensibility of each question. Due to the small number of changes made to the survey, no further pilot testing was conducted. The survey was composed of two sections: In the first section there were questions regarding the gender, duties and the tenure of the participants, and the clinic they work in; in the second section there were questions including the training and knowledge levels of the participants on OT. The questionnaire questions indicating the level of knowledge were prepared by the researcher based on the relevant literature and the study conducted in our country (18,19) (see Appendix-1 for the questionnaire form).

Data Collection Method

The data was obtained by distribution by hand and filling out the forms containing the study information note to doctors and nurses who were actively working in our hospital's adult patient emergency department, clinics and intensive care units (ICU) and who wanted to participate in the study voluntarily. Participants were asked to voluntarily self-administer the hard copy of the survey based on their perception of the topic, and the confidentiality of their responses was assured. Participants were informed that they could give more than one answer to some questions. Exclusion criteria included refusing to participate, having participated in the survey before, being on leave or sick leave during the study period, incompletely filling the survey or not returning the survey on the same day. According to the correct answers given to questions investigating knowledge levels, if the score was >80% it was classified as good level, and if <60% it was classified as poor level.

Statistical Analysis

The approximate sample size was calculated using the Power Analysis & Sample Size-11 software (NCSS statistical software, Kaysville, Utah, USA). In the sample size analysis performed with reference (18) to 95% confidence interval and 90% power (P1=0.12, P2=0.2, effect size= 0.08), the minimum number of patients to be reached was found to be 215. In our study, we recruited 231 people in total. The sample size was distributed according to the number of 154 nurses and 77 doctors. Statistical evaluation was completed using the Statistical Package For Social Sciences (SPSS Inc., Chicago, IL, USA) program version 18. For questions with multiple choice answers, where every clinician could tick all answers, frequencies of a single answer referred to the total number of respondents from that hospital so the sum of percentages is over 100%. Descriptive statistics are given as number and percentage. All

study analyses were conducted at a 95% confidence interval and with p<0.05.

RESULTS

Sample Characteristics

During the study, 422 of the 312 nurses and 184 doctors working in the adult patient emergency department and clinics and ICU of our hospital were reached and participation in the study was determined as 54.7% (n=231). Doctors made up 77 (33.3%) of the participants and these [26.8% (n=62) were assistants and 6.5% (n=15) were specialist doctors] and 154 (66.7%) of them were nurses. Seventy four employees were excluded from the study because they did not give consent, 54 employees did not return the questionnaire, and 63 employees filled out the questionnaire incompletely. The gender distribution of the participants, their place of clinic and the length of time they worked in the service are shown in Table I.

Comparison of knowledge levels between groups

While the rate of nurses who had "partial knowledge" about OT was 14.3%, this rate was 35.1% for doctors (p<0.001). 27.3% of nurses and 41.6% of doctors were using guidelines for OT and the rate of those who think that OT training is absolutely necessary is 90.3% among nurses and 85.7% among doctors.

Table I. General Characteristics of the Respondents

	n	%
Gender		
Male	82	35.5
Female	149	64.5
Years of work experience (including education time) (years)		
0-5	92	39.8
6-10	48	20.8
11-15	40	17.3
16-20	37	16
≥21	14	6.1
Place of clinic		
Surgical service	86	37.2
Internal service	66	28.5
ICU	49	21.2
Emergency service	30	13
The length of time they worked in the service		
0-5	167	72.3
6-10	29	12.6
11-15	20	8.7
16-20	13	5.6
≥21	2	0.9

ICU: Intensive Care Unit.

It was found that only 46.3% of the participants [50% of nurses (n=78), 38% of doctors (n=29)] received training on OT before working in the unit they worked in (p=0.076) and the most common training source of the participants was school [48.7% (n=38) for nurses, 51.7% (n=15) for doctors], and the rate of receiving in-service training is higher in nurses (38.5%) than in doctors (17.2%) (p=0.035). It was observed that for the remaining 6 nurses and 9 doctors, the most common sources of information on this subject were congress courses and orientation processes.

Although the differences in the duration and content of medical education compared to nursing education, the job responsibilities of nurses and doctors and the differences in postgraduate education cannot be ignored, the knowledge of doctors about OT was found to be lower than expected. In general, the rate of good knowledge among nurses was 9.7%, while it was 14.3% among doctors (p=0.418). Sixty three point six percent of doctors and 85.7% of nurses have poor knowledge about low-flow OT application ways, and 49.4% of doctors and 68.8% of nurses have poor knowledge about acute OT indications (respectively; p<0.001, p=0.004). Seventy one point four percent of doctors and 49.4% of nurses had a good level of knowledge about the expected clinical results of OT (p<0.001).

Comparison of knowledge levels in nurses according to years of working in the profession

The distribution of knowledge level according to the answers given to the question "What are the ways of applying high-flow O_2 therapy?" showed a statistically significant difference in nurses according to years of working in the profession (p=0.044). The rate of those with poor knowledge level was 88.6% in 0-5 year employees, 89.2% in 6-10 year employees, 90.6% in 11-15 year employees, 68.8% in 16-20 year employees and 66.7% in >21 year employees. Employees with more than 21 years of service have the most good knowledge (33.3%).

The distribution of knowledge level according to the answers given to the question "What are the indications for short-term (acute) O_2 therapy?" showed a statistically significant difference (p=0.019). The rate of those with poor knowledge level was 72.7% in 0-5 year employees, 78.4% in 6-10 year employees, 78.1% in 11-15 year employees, 53.1% in 16-20 year employees and 33.3% in >21 year employees. Employees with more than 21 years of service have the most good knowledge (66.7%).

The distribution of the level of knowledge according to the answers given to the question "What are the clinical consequences of inadequate O_2 therapy?" showed a statistically significant difference in nurses according to their years of working in the profession (p=0.045). Most of those with poor knowledge are those who have worked 0-5 years (95.5%).

Table II. Comparison of Knowledge Levels in Nurses According to Years of Working in the Profession

	Working years					p*
	0-5 (n=44)	6-10 (n=37)	11-15 (n=32)	16-20 (n=32)	>21 (n=9)	
What are the ways of applying low-flow OT?						
Poor	37 (84.1)	33 (89.2)	29 (90.6)	26 (81.3)	7 (77.8)	0.688
Good	7 (15.9)	4 (10.8)	3 (9.4)	6 (18.8)	2 (22.2)	
What are the ways of applying high-flow OT ?						
Poor	39 (88.6)	33 (89.2)	29 (90.6)	22 (68.8)	6 (66.7)	**0.044**
Good	5 (11.4)	4 (10.8)	3 (9.4)	10 (31.3)	3 (33.3)	
If the OT is applied with a simple face mask, how many L min^{-1} of opening the flow is equivalent to FiO_2=100%?						
Poor	27 (61.4)	27 (73)	21 (65.6)	18 (56.3)	8 (88.9)	0.344
Good	17 (38.6)	10 (27)	11 (34.4)	14 (43.8)	1 (11.1)	
If the OT is applied with a nasal cannula, how many L min^{-1} of opening the flow is equivalent to FiO_2=100%?						
Poor	23 (52.3)	22 (59.5)	17 (53.1)	17 (53.1)	8 (88.9)	0.335
Good	21 (47.7)	15 (40.5)	15 (46.9)	15 (46.9)	1 (11.1)	
What are the indications for acute OT?						
Poor	32 (72.7)	29 (78.4)	25 (78.1)	17 (53.1)	3 (33.3)	**0.019**
Good	12 (27.3)	8 (21.6)	7 (21.9)	15 (46.9)	6 (66.7)	
What are effects of long-term (chronic) OT?						
Poor	35 (79.5)	28 (75.7)	26 (81.3)	23 (71.9)	5 (55.6)	0.550
Good	9 (20.5)	9 (24.3)	6 (18.8)	9 (28.1)	4 (44.4)	
What are the expected clinical results of OT?						
Poor	26 (59.1)	15 (40.5)	17 (53.1)	17 (53.1)	3 (33.3)	0.417
Good	18 (40.9)	22 (59.5)	15 (46.9)	15 (46.9)	6 (66.7)	
What are the clinical consequences of inadequate OT?						
Poor	42 (95.5)[a]	30 (81.1)[ab]	23 (71.9)[b]	28 (87.5)[ab]	7 (77.8)[ab]	**0.045**
Good	2 (4.5)	7 (18.9)	9 (28.1)	4 (12.5)	2 (22.2)	
What are the parameters used in patient follow-up in OT?						
Poor	8 (18.2)	1 (2.7)	2 (6.3)	2 (6.3)	0 (0)	0.153
Good	36 (81.8)	36 (97.3)	30 (93.8)	30 (93.8)	9 (100)	
What are the benefits of following the guidelines on OT in ICU?						
Poor	22 (50)	19 (51.4)	14 (43.8)	12 (37.5)	1 (11.1)	0.204
Good	22 (50)	18 (48.6)	18 (56.3)	20 (62.5)	8 (88.9)	
What are the symptoms of oxygen toxicity?						
Poor	42 (95.5)	33 (89.2)	28 (87.5)	25 (78.1)	6 (66.7)	0.063
Good	2 (4.5)	4 (10.8)	4 (12.5)	7 (21.9)	3 (33.3)	

OT: Oxygen therapy, **ICU:** Intensive care unit, *Fisher Freeman Halton Test; a-b: There is no difference between working years with the same letter.

The rate of those with good knowledge is 4.5% among 0-5 year employees and 28.1% among 11-15 year employees. Here, knowledge levels differed between those working 0-5 years and those working 11-15 years in Table II.

Comparison of knowledge levels of nurses according to their place of work in the profession

The distribution of knowledge level according to the answers given to the question "What are the ways of applying high-flow O_2 therapy?" showed a statistically significant difference (p=0.001). The rate of those with poor knowledge level was

Table III: Comparison of Knowledge Levels of Nurses According to Their Place of Work in the Profession

	Place of work		p
	Ward (n=107)	ICU (n=47)	
What are the ways of applying low-flow OT?			
Poor	92 (86)	40 (85.1)	1.000*
Good	15 (14)	7 (14.9)	
What are the ways of applying high-flow OT ?			
Poor	97 (90.7)	32 (68.1)	**0.001***
Good	10 (9.3)	15 (31.9)	
If the OT is applied with a simple face mask, how many L min^{-1} of opening the flow is equivalent to FiO_2 =100%?			
Poor	75 (70.1)	26 (55.3)	0.111*
Good	32 (29.9)	21 (44.7)	
If the OT is applied with a nasal cannula, how many L min^{-1} of opening the flow is equivalent to FiO_2 =100%?			
Poor	68 (63.6)	19 (40.4)	**0.013***
Good	39 (36.4)	28 (59.6)	
What are the indications for acute OT?			
Poor	79 (73.8)	27 (57.4)	0.067*
Good	28 (26.2)	20 (42.6)	
What are effects of long-term (chronic) OT?			
Poor	86 (80.4)	31 (66)	0.085*
Good	21 (19.6)	16 (34)	
What are the expected clinical results of OT?			
Poor	57 (53.3)	21 (44.7)	0.420*
Good	50 (46.7)	26 (55.3)	
What are the clinical consequences of inadequate OT?			
Poor	92 (86)	38 (80.9)	0.571*
Good	15 (14)	9 (19.1)	
What are the parameters used in patient follow-up in OT?			
Poor	11 (10.3)	2 (4.3)	0.346**
Good	96 (89.7)	45 (95.7)	
What are the benefits of following the guidelines on OT in ICU?			
Poor	53 (49.5)	15 (31.9)	0.064*
Good	54 (50.5)	32 (68.1)	
What are the symptoms of oxygen toxicity?			
Poor	100 (93.5)	34 (72.3)	**0.001***
Good	7 (6.5)	13 (27.7)	

OT: Oxygen therapy, **ICU:** Intensive care unit, *** :** Yates Correction, ****:** Fisher's Excat Test.

90.7% among those working in the ward and 85.1% among those working in the ICU. The rate of those with good knowledge was 9.3% among those working in the ward and 31.9% among those working in the ICU.

In the nurses, the distribution of knowledge level according to the answers given to the question "If the OT is applied with a nasal cannula, how many L min^{-1} of opening the flow is equivalent to FiO_2=100%?" showed a statistically significant difference (p=0.013). The rate of those with a poor level of knowledge was 63.6% among those working in the ward and 40.4% among those working in the ICU. The rate of those with good knowledge level was 36.4% among those working in the ward and 59.6% among those working in the ICU.

The distribution of knowledge level according to the answers given to the question "What are the symptoms of oxygen toxicity?" showed a statistically significant difference (p=0.001). The rate of those with poor knowledge level was 93.5% among those working in the ward and 72.3% among those working in the ICU. The rate of those with good knowledge level was 6.5% among those working in the ward and 27.7% among those working in the ICU (Table III).

Comparison of knowledge levels in doctors according to years of working in the profession and their place of work

The knowledge levels of doctors were compared according to their years of professional work after receiving basic medical education. Doctors made up 77 (33.3%) of the participants and these [26.8% (n=62) were assistants and 6.5% (n=15) were specialist doctors. Among the assistants, 77.4% (n=48) had 0-5 years of experience, 17.8% (n=11) had 6-10 years of experience and 4.8% (n=3) had more than 10 years of experience.

According to the answers given to the questions according to their place of work and the level of knowledge according to years of working did not show a statistically significant difference (p>0.050) (Table IV and V).

DISCUSSION

In our study, it was found that a significant proportion of doctors and nurses had lower than expected levels of knowledge about OT and their knowledge about OT application methods was inadequate. When nurses were compared according to their working places and years, it was observed that experienced nurses and those working in intensive care had better knowledge about OT, while no difference was observed in doctors according to their working times and years. It was observed that all participants received training on OT during their undergraduate and graduate education and did not include guidelines in OT applications.

There are many studies showing that there is a lack of knowledge about OT among healthcare personnel (20-22). A fairly recent study investigating knowledge of doctors and nurses on acute OT showed that only 26.7% of participants had good knowledge (score ≥80%) and rarely used guidelines for OT. It is noteworthy that only 5% of the nurses in the study had good knowledge of OT. In addition, the need for continuous professional development and administrative interventions regarding OT was underlined, and it was stated that there was a need to develop local protocols and national guidelines or policies regarding OT to increase knowledge and change practice behavior (21). In the study of Aloushan et al. in which they evaluated the knowledge, conduct and practices of emergency room personnel regarding OT, it was reported that only 12.4% of the participants had a good level of knowledge about the application of OT to treat and prevent hypoxia, 69.8% about contraindication of OT and 84.2% of the fact that OT may harm patients if used inappropriately (18). In the same study, it was reported that 80.9% of the participants were trained on how to provide OT, 60.1% were aware of the existence of OT guides in their emergency rooms, and the presence of OT guides and protocols in the work area was significantly associated with a good level of knowledge. In a similar multicenter study by Demilew et al. it was reported that approximately 68.7% of the participants had a good level of knowledge, and this rate was much higher than similar studies (22-25). At the same time, this study reported that healthcare workers who had recently graduated (≤4 years) were approximately twice as likely to have a good level of knowledge about O_2 (22). This situation supports the study conducted in Turkey, where the knowledge score is significantly higher in those who have worked in the same department for ≤5 years, and is significantly lower in those who have worked in the same department for ≥14 years (19). In contrast to this study, no difference was observed in doctors in our study, whereas we attribute the increase in the knowledge level of nurses with increasing experience to their active participation in OT in the wards where they work. In our study, it can be said that the knowledge level of healthcare professionals regarding OT is lower than expected. 77.4% of our participants had knowledge on how OT is performed. However, the rate of our total participants with good knowledge was quite low (11.25%). Only 37.6% of all participants had good knowledge on acute OT indications. This conclusion is also supported by studies showing that there are significant knowledge gaps among healthcare personnel. We attribute these differences in our results to study participants, study environments, and sample differences.

Awareness of the use of guidelines or protocols for OT appears to vary among healthcare professionals (16,18,21). In the study of Desalu et al. it was determined that 35.9% of

Table IV: Comparison of Knowledge Levels in Doctors According to Years of Working in the Profession

	Working years					p*
	0-5 (n=48)	6-10 (n=11)	11-15 (n=8)	16-20 (n=5)	>21 (n=5)	
What are the ways of applying low-flow OT?						
Poor	30 (62.5)	10 (90.9)	4 (50)	2 (40)	3 (60)	0.211
Good	18 (37.5)	1 (9.1)	4 (50)	3 (60)	2 (40)	
What are the ways of applying high-flow OT?						
Poor	37 (77.1)	11 (100)	6 (75)	3 (60)	3 (60)	0.174
Good	11 (22.9)	0 (0)	2 (25)	2 (40)	2 (40)	
If the OT is applied with a simple face mask, how many L min^{-1} of opening the flow is equivalent to FiO_2=100%?						
Poor	27 (56.3)	7 (63.6)	4 (50)	2 (40)	3 (60)	0.927
Good	21 (43.8)	4 (36.4)	4 (50)	3 (60)	2 (40)	
If the OT is applied with a nasal cannula, how many L min^{-1} of opening the flow is equivalent to FiO_2=100%?						
Poor	25 (52.1)	6 (54.5)	4 (50)	2 (40)	3 (60)	0.994
Good	23 (47.9)	5 (45.5)	4 (50)	3 (60)	2 (40)	
What are the indications for acute OT?						
Poor	23 (47.9)	7 (63.6)	4 (50)	3 (60)	1 (20)	0.628
Good	25 (52.1)	4 (36.4)	4 (50)	2 (40)	4 (80)	
What are effects of long-term (chronic) OT?						
Poor	35 (72.9)	8 (72.7)	5 (62.5)	4 (80)	4 (80)	0.987
Good	13 (27.1)	3 (27.3)	3 (37.5)	1 (20)	1 (20)	
What are the expected clinical results of OT?						
Poor	13 (27.1)	2 (18.2)	2 (25)	4 (80)	1 (20)	0.159
Good	35 (72.9)	9 (81.8)	6 (75)	1 (20)	4 (80)	
What are the clinical consequences of inadequate OT?						
Poor	36 (75)	9 (81.8)	7 (87.5)	5 (100)	5 (100)	0.743
Good	12 (25)	2 (18.2)	1 (12.5)	0 (0)	0 (0)	
What are the parameters used in patient follow-up in OT?						
Poor	2 (4.2)	2 (18.2)	1 (12.5)	1 (20)	0 (0)	0.212
Good	46 (95.8)	9 (81.8)	7 (87.5)	4 (80)	5 (100)	
What are the benefits of following the guidelines on OT in ICU?						
Poor	16 (33.3)	4 (36.4)	2 (25)	2 (40)	0 (0)	0.661
Good	32 (66.7)	7 (63.6)	6 (75)	3 (60)	5 (100)	
What are the symptoms of oxygen toxicity?						
Poor	40 (83.3)	11 (100)	7 (87.5)	5 (100)	4 (80)	0.556
Good	8 (16.7)	0 (0)	1 (12.5)	0 (0)	1 (20)	

OT: Oxygen therapy, **ICU:** Intensive care unit, ***** Fisher Freeman Halton Test.

202 participants were aware of the British Thoracic Society or World Health Organization (WHO) guidelines, 22.8% had read and were familiar with these guidelines, but only 19.3% has been using these guides (21). In a study conducted in Ethiopia in 2015, it was reported that there were large differences in terms of nurses' knowledge, conduct and practices regarding OT, and the possible factors contributing to this were the lack of OT guidelines, insufficient training and heavy workload (16). It is seen that 32% (n=74) of our participants benefited from the guidelines for OT, which is quite high compared

Table V. Comparison of Knowledge Levels of Doctors According to Their Place of Work in the Profession

	Place of work		p*
	Ward (n=74)	ICU (n=3)	
What are the ways of appliying low-flow OT?			
Poor	46 (62.2)	3 (100)	0.297
Good	28 (37.8)	0 (0)	
What are the ways of applying high-flow OT?			
Poor	57 (77)	3 (100)	1.000
Good	17 (23)	0 (0)	
If the OT is applied with a simple face mask, how many L min^{-1} of opening the flow is equivalent to FiO_2 =100%?			
Poor	41 (55.4)	2 (66.7)	1.000
Good	33 (44.6)	1 (33.3)	
If the OT is applied with a nasal cannula, how many L min^{-1} of opening the flow is equivalent to FiO_2=100%?			
Poor	38 (51.4)	2 (66.7)	1.000
Good	36 (48.6)	1 (33.3)	
What are the indications for acute OT?			
Poor	37 (50)	1 (33.3)	1.000
Good	37 (50)	2 (66.7)	
What are effects of long-term (chronic) OT?			
Poor	54 (73)	2 (66.7)	1.000
Good	20 (27)	1 (33.3)	
What are the expected clinical results of OT?			
Poor	22 (29.7)	0 (0)	0.553
Good	52 (70.3)	3 (100)	
What are the clinical consequences of inadequate OT?			
Poor	60 (81.1)	2 (66.7)	0.483
Good	14 (18.9)	1 (33.3)	
What are the parameters used in patient follow-up in OT?			
Poor	6 (8.1)	0 (0)	1.000
Good	68 (91.9)	3 (100)	
What are the benefits of following the guidelines on OT in ICU?			
Poor	23 (31.1)	1 (33.3)	1.000
Good	51 (68.9)	2 (66.7)	
What are the symptoms of oxygen toxicity?			
Poor	64 (86.5)	3 (100)	1.000
Good	10 (13.5)	0 (0)	

OT: Oxygen therapy, **ICU:** Intensive care unit, *Fisher's Exact Test.

to similar studies. Since our participants were not asked, ''Is there an implementation guide or any protocol for OT in your institution?'', we could not determine their awareness on this issue. However, we found that OT application protocols were only available in ICUs in our hospital. Those working in the ICU constituted 21.2% of our total participants. Healthcare professionals managing OT based on their own experience does not always ensure good quality treatment of patients. Therefore, the development of a locally updated OT guidelines and protocols will ultimately support practitioners' awareness and practice, which will increase knowledge of OT.

The study reported that the most common source of information about OT was medical/nursing school (75.2%), followed by 23.4% postgraduate training/in-service training, 1.5% websites, medical textbooks and journals. Only 20.5% have received professional training in OT (21). In the study of Demirel and Kazan it was reported that the majority of nurses did not receive training on OT, and the majority of those who received a training on the subject received it at their schools (19). It was concluded in the study that there was no significant difference in the median knowledge scores of nurses regarding OT between those who received this training and those who did not, and that the training content given to the nurses participating in the research during both academic studies and in-service training was not sufficient. In our study, 86.7% of doctors and 90.3% of nurses thought that training for OT was absolutely necessary. The rate of receiving training on OT before working in the unit where our participants worked was 46.3%, and it seems that the most common source of information on this subject is school and in-service training. It appears that our participants did not receive sufficient training on OT during their undergraduate or graduate education or after graduating from these programs. Our results will contribute to determining the training needs of healthcare professionals regarding OT and will guide future research.

Oxygen therapy application method and O_2 flow rate should be determined by the physician. The study conducted by Adipa et al. revealed that emergency nurses did not have sufficient knowledge about O_2 application methods (26). In the study where the questions related to correctly matching the masks used for OT with the images were asked, it was reported that the success rate of the nurses was quite low (19). Similar results were obtained in other studies on the same subject (27,28). Eastwood et al. study reported that until solid evidence is obtained from clinical studies or to support clinical practice guidelines and nurses become more accepting that this knowledge constitutes the basis of their practice, differences in OT practices among ICU nurses are likely to persist (29). It has been shown that doctors' current practice of OT in anesthesia practice does not comply with the latest recommendations of the WHO and is not always evidence-based (30). The majority of our participants gave incorrect answers to the questions about OT application methods, but while the knowledge levels of doctors did not differ according to their working places, it was observed that the knowledge levels of nurses working in intensive care were higher than those working in the ward. We can attribute this to the fact that intensive care nurses take more role in patient care than ward nurses and actively participate in OT. In general, our results show that our participants' knowledge level regarding both low and high flow OT application methods is insufficient. The fact that some of these methods were not frequently used in clinics may have affected our results. We believe that more observational and interventional studies aiming to improve OT are needed.

There were several limitations regarding this study. First of all, since only one center was included in the study, the results of the research are limited to the hospital where the research was conducted and it is planned to be conducted with a larger sample. Therefore, this study can't be generalized to other settings. Secondly, many people are busy during working hours and may have read the survey with insufficient concentration; this may have led to under- or over-reporting of results. Finally, the knowledge level of the participants is limited to the answers given to the survey prepared by the researchers.

CONCLUSION

It was observed that the knowledge level of a significant portion of doctors and nurses regarding OT was lower than expected, that they received information about OT only during their undergraduate and graduate education, that their knowledge was insufficient, especially about OT application methods, and that they did not include guidelines in OT application. In line with these results, we can make the following suggestions: Nurses and doctors should be given theoretical and practical training at undergraduate and graduate levels to improve their knowledge and skills regarding OT; protocols regarding OT should be established in hospitals and employees should be informed about updated OT guidelines; in-service training programs should be organized and the continuity of these programs should be ensured.

AUTHOR CONTRIBUTIONS

Conception or design of the work: KB, GK
Data collection: SA
Data analysis and interpretation: KB, GK
Drafting the article: KB, GK, HA
Critical revision of the article: HA
Other (study supervision, fundings, materials, etc): KB, GK
The author (KB, GK, SA, HA) reviewed the results and approved the final version of the manuscript.

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APPENDIX-1

Training and Knowledge Status of Doctors and Nurses on Oxygen Therapy in a Level Three Hospital - Survey Study

Dear Employee,

The following questions were prepared to evaluate the attitudes and behaviours of healthcare professionals (doctors, nurses) working in our hospital about oxygen therapy. Answering the survey questions is voluntary. You are not asked to write your name and surname on the forms given to you. In addition, your answers to the questions will be evaluated collectively not individually and confidentiality will be ensured by the researchers. Please mark the appropriate option with X after reading the statements. The duration of the survey is approximately 15 minutes. If you have already answered our questionnaire, please do not answer it again. Thank you for taking the time to participate in our survey. (Dr. Keziban Bollucuoğlu, Anesthesiology and Reanimation AB)

QUESTIONS

1. **Your age?**.....(year)

2. **Gender?**
   A. Male B. Female

3. **Your occupation?**
   A. Nurse B. Resident doctor C. Specialist doctor

4. **Years of service in the profession (including your education period)?**
   A. 0-5 years
   B. 6-10 years
   C. 11-15 years
   D. 16-20 years
   E. 21 years and over

5. **Which service and/or intensive care unit (ICU) do you work in?**
   A. Cardiology
   B. Neurology
   C. Pulmonology
   D. Emergency medicine
   E. Internal diseases
   F. Infectious diseases
   G. Psychiatry
   H. Orthopaedics
   I. Cardio-vascular surgery
   J. Otorhinolaryngology surgery
   K. Gynaecology and obstetric surgery
   L. Urology
   M. General surgery
   N. Neurosurgery
   O. Plastic surgery
   P. Anesthesia
   Q. Ophthalmology
   R. Other (specify):.....
   S. Coronary intensive care unit (B4)
   T. Coronary intensive care unit (B2)
   U. Anesthesiology and reanimation intensive care unit (B3)
   V. Cardiovascular surgery intensive care unit
   W. General intensive care unit (C3)
   X. Respiratory intensive care unit

6. **How long have you been working in your current service and/or ICU?**
   A. 0-5 years
   B. 6-10 years
   C. 11-15 years
   D. 16-20 years
   E. 21 years and over

7. **Did you receive any training on oxygen applications before working in your unit?**
   A. Yes-I did (skip to question 9)
   B. No-I did not (skip to question 10)

8. **If you have received any training on oxygen applications, where did you receive the training?**
   A. In-service training
   B. School education
   C. Orientation training
   D. Congress/course programmes
   E. Other, please specify:

9. If you have not received any training on oxygen applications, what do you think about receiving the training?

A. Yes, it should be done
B. No, it should not be done
C. I do not have enough information yet

10. Do you think that training is necessary for healthcare professionals on oxygen applications?

A. Yes
B. No
C. Partially
D. I don't have enough information yet

11. Do you use special protocols or guidelines for oxygen administration?

A. Yes B. No C. I do not have enough information yet

12. On average, how many patients do you follow who need oxygen in a day? (Specify number: .....)

13. Which are the ways of administering low-flow system oxygen therapy? (You can choose more than one option?

A. Nasal cannula
B. Simple face mask
C. Partial reversible mask
D. Non-rebreather mask
E. I do not have enough information yet
F. Other: (please explain).....

14. What are the ways of administering high-flow system oxygen therapy (you can tick more than one option)?

A. Venturi mask
B. Aerosol mask
C. High flow O_2 (HFO)
D. Continuous positive pressure ventilation (CPAP)
E. I do not have enough information yet
F. None

15. In the patient you are applying oxygen therapy with a face mask, when you open the flow at how many L min^{-1}, FiO_2 is equivalent to 100%?

A. 2-3 L min^{-1}
B. 4-5 L min^{-1}
C. 7-8 L min^{-1}
D. None
E. Other: (please specify).....L min^{-1}

16. In the patient you are applying oxygen therapy with nasal cannula, when you open the flow at how many L min^{-1}, FiO_2 is equivalent to 100%?

A. 2-3 L min^{-1}
B. 4-5 L min^{-1}
C. 7-8 L min^{-1}
D. None
E. Other: (please specify)... L min^{-1}

17. What are the indications for short-term (acute) oxygen therapy (You can tick more than one option)?

A. Acute hypoxaemia (PaO_2 <60 mmHg, SaO_2 <90%)
B. Cardiac and respiratory arrest
C. Hypotension (systolic blood pressure <100 mmHg)
D. Low cardiac output and metabolic acidosis
E. Respiratory distress (respiratory rate >24 min^{-1})
F. I don't have enough information yet

18. Which of the following statements about long-term (chronic) oxygen therapy is/are correct? (You can select more than one option)?

A. Corrects polycythaemia.
B. Reduces pulmonary artery pressure.
C. Improves right and left ventricular function.
D. Reduces periods of severe desaturation in hypoxaemic patients with COPD.
E. Reduces dyspnea in hypoxaemic patients with COPD.
F. Improves neuropsychiatric functions.
G. Improves exercise tolerance.
H. Reduces the need for hospitalisation.
G. I do not have enough information yet

19. Which of the following clinical outcomes would you expect to observe in patients to whom you provide oxygen support (You can select more than one option)?

A. Decrease in infections
B. Reduction in complications
C. Acceleration of wound healing
D. Decrease in hospitalisation periods
E. I do not have enough information yet

20. Which of the following outcomes do you most often witness when you think that oxygen support is not adequately provided (You can choose more than one option)?

A. Increased risk of infection
B. Delay in wound healing
C. Complications of surgical incisions, sutures and anastomoses
D. Muscle weakness
E. Cardiac dysfunction
F. Metabolic acidosis
G. Respiratory function disorders
H. Difficulties in transition to spontaneous breathing in patients on ventilator support
I. Prolonged recovery and hospitalisation
J. I don't have enough information yet

21. What do you think is the biggest contribution of following the guidelines on oxygen support in patients hospitalised in intensive care units? (You can choose more than one option)

A. I think it will reduce the length of hospitalisation of patients in intensive care units.
B. I think it will contribute to the economy.
C. I think that complications such as infection and pressure sores can be seen less frequently by following the precautions.
D. I do not think it will make any contribution.
E. Other (please explain):.....

22. Do you have information about oxygen toxicity?

A. Yes (skip to question 32)
B. I don't have enough information yet (skip to question 34)
C. No (skip to question 34)

23. Which of the symptoms of oxygen toxicity is/are correct? (You can tick more than one option)

A. Chest distress, pain, dyspnea
B. Restlessness, fatigue, weakness,
C. Increasing difficulty in breathing, cough, paresthesia
D. Infiltration on chest X-ray
E. Central nervous system (CNS) toxicity, epileptic seizures
F. None