

Survey to Assess the Knowledge of Postgraduate Residents about Acute Oxygen Therapy

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Abstract

Introduction: Oxygen is among the commonly used drugs in acute care settings. Overall, prescribing and administration practices of supplemental oxygen are comparably poor. There are gaps in knowledge of healthcare professionals (HCPs) working in acute care settings regarding oxygen therapy. Objective of this study was to assess knowledge about acute oxygen therapy of residents recently joined Universal College of Medical Sciences, Nepal.

Methodology: This is a descriptive survey. Structured and validated questionnaire was used for collection of data. Questionnaire is comprised of 8 sections containing 35 closed-ended and one open ended questions regarding major challenges. The sections are on "Residents' Characteristics", "Relevant Educational Background", "Awareness and Use of Oxygen Therapy Guidelines", "General Knowledge of Oxygen", "Recognizing Hypoxaemia", "Indications for Acute Oxygen", "Oxygen Prescription" and "Oxygen Delivery Practices". Data was analyzed using SPSS version 21.

Results: Twenty-seven residents with mean age 28.76 ± 2.85 years participated in survey done in June 2019; 77.8% was from medical background. More than 85% were not aware of WHO/Any Oxygen Therapy Guideline; 59.3% didn't agree oxygen is medication; 92.6% believed hypoxemia can be recognized by clinical signs; 96.3% believed ABG is useful for confirming hypoxaemia; 96.3% agreed central cyanosis is indication of acute oxygen therapy; 85.2% responded flow rate or FIO₂ be documented in treatment chart; 44.4% agreed nasal catheter at 1 - 2 L/min/ is appropriate device for oxygen delivery achieving target saturation 88 - 92% in 72-year-old farmer with COPD with type II respiratory failure; 92.6% agreed FIO₂ of 60% is correct in 12-year-old with type I respiratory failure achieving target saturation of 94 - 98%. Inadequate knowledge and lack of training of HCPs among the major challenges identified by participants.

Conclusion: There is a gap in knowledge of residents about oxygen therapy, besides challenges. To raise awareness of the residents and other HCPs, educational programs related to oxygen therapy need to be organized.

Keywords: Drug; Knowledge; Oxygen Therapy; Prescribing Practices; Residents; Survey

Introduction

World Health Organization (WHO) list of essential medicine mentions oxygen among the core drugs used in the healthcare system [1,2]. Supplemental Oxygen is among the commonly prescribed drugs used in various clinical conditions in different settings [3-5]. Oxygen is a very essential element for managing hypoxemia in acute care conditions [1]. It is vital drug used for improving saturation and reducing efforts of breathing for a wide variety of hospitalized patients [1,6,7]. When oxygen is used properly and correctly, then it decreases mortality, but if erroneously it may be harmful to the patient resulting in adverse reactions [3].

Oxygen as a drug, must be prescribed; the prescription includes dose, duration, method of delivery, device of delivery, defined target arterial oxygen saturation range (SaO₂) and monitoring process. Like other drugs order, oxygen order must be included in a treatment chart before administration [3,8,9]. The prescribing practices of oxygen has been reviewed over many years in the acute care hospital setting; overall, the practices are poor as suggested in the literature [4].

There are gaps in knowledge of healthcare professionals working in acute care settings regarding oxygen therapy. The knowledge and practice gap are common phenomenon observed in healthcare settings [4,7,10]. To the best of our understanding, no study has been conducted in Nepal to identify the knowledge of health care professionals. Overall, the literature suggests that the practices of prescribing oxygen are poor [1,4].

Objective of the Study

The objective of this study was to assess the knowledge of postgraduate residents about acute oxygen therapy who recently joined residency program at Universal College of Medical Sciences Bhairahawa, Nepal.

Methodology

This is a descriptive survey about the knowledge of acute oxygen therapy of post graduate residents who recently joined residency program at Universal college of Medical Sciences (UCMS) Bhairhawa Nepal. The validated questionnaire designed and validated by Desalu OO., *et al.* utilized with permission for collection of information (data) from the first-year residents of medical, dental and nursing colleges of UCMS.

The questionnaire is comprised of 8 sections containing 35 questions besides questions regarding major challenges of oxygen administration in the hospital ward and emergency room.

Section 1 is on "Residents' Characteristics" contains eight questions (question 1 - 8).

Section 2 is on "Relevant Educational Background" contains three questions (question 9 - 11).

Section 3 is "Awareness and Use of Oxygen Therapy Guidelines" contains three closed ended questions (question 12 - 14).

Section 4 is on "General Knowledge of Medical Oxygen" contains four closed ended questions (question 15 - 18).

Section 5 is on "Recognizing Hypoxaemia" contains five closed ended questions (question 19 - 23).

Section 6 is on "Indications for Acute Oxygen" contains four closed ended questions (question 24 - 27).

Section 7 is on "Oxygen Prescription" contains four closed ended questions (question 28 - 31).

Section 8 is on "Oxygen Delivery Practices" contains four closed ended questions (question 32 - 35).

The data was collected during one-day Research Methodology Training for first year residents held in month of June at UCMS.

The informed consent was taken from the participants and ethical approval was obtained from institutional review committee of UCMS.

The data collected was checked for completeness, accuracy and consistency. It was entered in IBMS SPSS version 21 for analysis. Descriptive analysis was done; the frequency, mean and standard deviation were computed.

Results

Section 1: Residents’ characteristics

The age of residents was 28.76 ± 2.85 years (range 26 - 38 years); 23 (85.2%) were between 26 - 29 years of age while 4 (14.8%) between 33 - 38 years. Fifteen residents (55.6%) were males and 12 (44.4%) females. The total no of participants was 27; 21 (77.8%) from medical college (Emergency 1, Surgery 4, Pediatrics 2, Psychiatry 3, Anesthesia 3, Orthopedics 3, Clinical Pathology 5), 4 (14.8%) from college of dentistry (Orthodontics 1, Endodontics 2, Oral and facio-maxillary Surgery 1) and 2 (07.4%) from college of nursing (02 Adult Nursing). Their qualification was: MBBS (Bachelor of medicine and surgery) 21 (77.8%), BDS (Bachelor of dental surgery) 04 (14.8%) and BN (Bachelor of Nursing) 02 (07.4%). No one has any additional qualification.

Information regarding “Practice after graduation in months”, “Working in this hospital or health facility”, “How long ago did you administer oxygen to a patient?” and “How long ago did you prescribe oxygen to a patient?” is mentioned in table 1a-1d respectively.

	12 months	14 months	18 months	24 months	30 months	36 months	48 months	132 months
No	5	1	4	9	1	5	1	1
%	18.5	3.7	14.9	33.4	3.7	18.5	3.7	3.7

Table 1a: Practice after graduation in months.

	1 month	11 months	24 months	36 months	60 months
No	22	1	2	1	1
%	81.5	3.7	7.4	3.7	3.7

Table 1b: Working in this hospital or health facility (UCMS).

	< 1 month	1 - 6 months	> 6 months
No	14	2	11
%	51.9	7.4	40.7

Table 1c: How long ago did you administer oxygen to a patient?

	< 1 month	1 - 6 months	> 6 months
No	14	5	8
%	51.9	18.5	29.6

Table 1d: How long ago did you prescribe oxygen to a patient?

Section 2: Relevant educational background

- Have you received any CME/update/special training on oxygen therapy?

Response: None of the participants received any formal training before.

- Major sources of information on the oxygen therapy

Response: Twenty-four participants mentioned only one source while 3 more than one source (Table 2).

	Medical training	Post-qualification in-service training	Colleagues	Journals	Print and electronic media	Others
No	16	2	4	2	0	3
%	59.3	7.4	14.8	7.4	0	11.1

Table 2: Sources of information on the oxygen therapy.

Responses to questions of Section 3-8

Responses of section 3-8 are mentioned in table 3-8 respectively.

Statement	Yes	No
Are you aware of WHO/Any other guideline on Oxygen Therapy?	5 (18.5%)	22 (81.5%)
Have you ever read it?	5 (18.5%)	22 (81.5%)
Have you ever used or applied it in your practice?	5 (18.5%)	22 (81.5%)

Table 3: Section 3: Awareness and use of oxygen therapy guidelines.

Statement	True	False
Oxygen is like any other medication	11 (40.7%)	16 (59.3%)
Oxygen is not medication but a supportive therapy	19 (70.4%)	08 (29.6%)
Oxygen should only be given after doctors' prescription	11 (40.7%)	16 (59.3%)
Oxygen promotes combustion	23 (85.2%)	04 (14.8%)

Table 4: Section 4: General knowledge of medical oxygen.

Statement	True	False
Hypoxemia can be recognized by clinical signs	25 (92.6%)	02 (07.4%)
Blood Gas Analysis is useful for confirming hypoxaemia	26 (96.3%)	01 (03.7%)
Breathlessness is not always a sign of hypoxaemia	23 (85.2%)	04 (14.8%)
Pulse Oximetry is useful in detecting and monitoring hypoxaemia	22 (81.5%)	05 (18.5%)
SpO ₂ level < 90 % in adults define hypoxaemia	19 (70.4%)	08 (29.6%)

Table 5: Section 5: Recognizing hypoxaemia.

Item	True	False
Central Cyanosis	26 (96.3%)	01 (03.7%)
Asymptomatic Anaemia	11 (40.7%)	16 (59.3%)
Eclampsia	20 (74.1%)	07 (25.9%)
Restlessness and Convulsion in children	23 (85.2%)	04 (14.8%)

Table 6: Section 6: Indications for acute oxygen therapy.

Item	Response a	Response b	Response c
Which of the following should be documented in the treatment (prescription) chart of a patient receiving oxygen?	Oxygen Volume	Oxygen Flow Rate or FIO ₂	Oxygen Diffusion Rate
	03 (11.1%)	23 (85.2%)	01 (3.7%)
Which of the following should be documented in the treatment (prescription) chart of a patient receiving oxygen?	Oxygen Solubility	Oxygen Source and Delivery Device	Oxygen Density
	02 (07.4%)	22 (81.5%)	03 (11.1%)
Which of the following should be documented in the treatment (prescription) chart of a patient receiving oxygen?	Oxygen Odour	Frequency of Administration	Oxygen and Nitrogen Concentration
	01 (3.7%)	22 (81.5%)	04 (14.8%)
Which of the following statement on the prescription of oxygen and delivery is correct?	Nasal catheter oxygen flow rate > 5 L/min lead to rebreathing of CO ₂	Oxygen prescription should be to a target saturation range rather than a fixed dose	Oxygen concentrator delivers maximum oxygen concentration of 70%
	11 (40.7%)	12 (44.4%)	04 (14.8)

Table 7: Section 7: Oxygen prescription.

Item	Response a	Response b	Response c
A 72-year-old farmer with COPD has carbon dioxide retention (type II respiratory failure), which of this device is appropriate for oxygen delivery to achieve a target saturation of 88-92%?	Nasal catheter at 1-2 L/min/ in the absence of Venturi masks	Nasal catheter at 16 L/min	Oxygen mask with reservoir 6-9L/min
	12 (44.4%)	01 (03.7%)	14 (51.9%)
A 12-year-old boy had type 1 respiratory failure, select one correct initial concentration of oxygen to achieve a target saturation of 94 - 98%.	FiO ₂ of 60%	FiO ₂ of 20%	FiO ₂ of 150%
	25 (92.6%)	02 (07.4%)	0 (0%)
Humidification is essential for patients receiving oxygen through one of the following devices:	Endotracheal tube or a tracheostomy	Nasal Prong	Oxygen mask
	09 (33.3%)	04 (14.8%)	14 (51.9%)
Regarding weaning and discontinuation of oxygen which of the following statement is true?	Weaning and discontinuation of oxygen therapy should be started if clinically stable on low-dose oxygen	Weaning and discontinuation of oxygen therapy should be commenced after a new chest radiograph is normal	Weaning of oxygen therapy should be initiated if clinically stable on high-dose oxygen
	25 (92.6%)	02 (07.4%)	0 (0%)

Table 8: Section 8: Oxygen delivery practices.

The major challenges of oxygen administration in the hospital ward and emergency room

The major challenges identified by the participants were:

1. Inadequate knowledge of healthcare professionals regarding oxygen therapy
2. Lack of training of healthcare professionals related to oxygen therapy
3. Lack of resources
4. Inadequate supply of equipments and oxygen
5. No central supply in wards
6. Lack of periodic maintenance of equipment/devices
7. Unavailability of standardized protocol for oxygen therapy in emergency, intensive care and wards
8. No practice for writing prescription for oxygen therapy
9. Unclear and incomplete verbal order for oxygen therapy
10. Patient don't have knowledge about oxygen therapy.

Discussion

Oxygen is one of the most commonly used drugs in emergencies. Patients can be affected by getting no oxygen or too little or too much oxygen. It is appropriate to provide optimal concentration of supplemental oxygen to the acutely ill hypoxemic patient; inadequate oxygen administration may result in cardiac arrhythmias, tissue injury, renal injury and ultimately cerebral damage [1,11-13].

Providing oxygen therapy is one of the important tasks of both resident doctors and resident nurses for maintenance of the patients' safety as resident doctors have to prescribe the supplemental oxygen and write orders on the patients' treatment chart while nurses have to administer and monitor the oxygen therapy [14]. It seems from poor prescribing and administration practices of supplemental oxygen, most likely the oxygen therapy is not properly understood and interpreted by many healthcare professionals [4,8,15]. Inadequate knowledge about supplemental oxygen and the equipment required and used to administer oxygen to patients are among the barriers to optimal delivery of oxygen to the patients [3,4].

The present study is about the knowledge of acute oxygen therapy of post graduate residents who recently joined the residency program at medical, dental and nursing colleges of UCMS Bhairhawa, Nepal. The validated questionnaire designed and validated by Desalu OO., *et al.* was used for this study with permission [3].

In the present study 27 residents participated; the majority (85%) of them were between 26 - 29 years of age. Male to female ratio was 5:4. Most of the residents were from medical background (77.8%) who joined various department of medical college. The practice experience of most of the participants (more than 70%) was within 2 years. Majority (81.5%) of them joined UCMS one month back. Almost all (96.3%) administered oxygen to the patient within last six months and all prescribed oxygen to the patient within last six months. None of the participants received any specific training on oxygen therapy but got information from other sources.

Responses of residents on statements: Regarding "Awareness and Use of Oxygen Therapy Guidelines"; more than 81% residents were not aware of WHO/Any other guideline on Oxygen Therapy, more than 81% ever read any guidelines and ever used or applied it in their practice. With respect to the "General Knowledge of Medical Oxygen" of residents; more than 59% didn't agree that oxygen is like any other medication, more than 70% agreed that oxygen is not medication but a supportive therapy, more than 59% didn't agree that oxygen should only be given after doctors' prescription and more than 85% agreed that oxygen promotes combustion.

Evidence: Oxygen is considered and treated as a drug like all others drugs. It should be prescribed for specific indications. The prescription must mention dose, method of delivery, defined arterial saturation target, duration of therapy and monitoring method [3,9]. It must be dated and signed by clinician [12].

Responses of residents on statements: As far as “Recognizing Hypoxaemia” is concerned; more than 92% believed that hypoxemia can be recognized by clinical signs, more than 96% believed that blood gas analysis is useful for confirming hypoxaemia; more than 85% believed that breathlessness is not always a sign of hypoxaemia more than 81% believed that pulse oximetry is useful in detecting and monitoring hypoxaemia and more than 71% believed SpO_2 level $< 90\%$ in adults define hypoxemia.

Evidence: At initial assessment of patient, oxygen saturations can be determined by pulse oximetry. But clinicians need to know that the accuracy of pulse oximetry is variable in clinical practice. Arterial blood gases must be measured in patients who are critically ill, when an oximetry reading cannot be obtained or when hypercapnia is suspected [9]. The accepted definition of hypoxaemia is a $SpO_2 < 90\%$ or $PaO_2 < 8$ kPa [16].

Responses of residents on statements: Regarding responses to “Indications for Acute Oxygen Therapy”; more than 96% agreed that central cyanosis is indication of acute oxygen therapy, more than 59% didn’t agree that asymptomatic anemia is indication of acute oxygen therapy, more than 74% agreed that eclampsia is indication of acute oxygen therapy and more than 85% agreed that restlessness and convulsion in children is indication of acute oxygen therapy.

Evidence: Oxygen therapy is indicated in patients with oxygen saturations below the target saturation range [9]. The target saturations for acutely ill patient is between 94 - 98% but it is lowered for patient with suspected risk of hypercapnia (Type II respiratory failure) between 88 - 92% [1,8,12,17]. Oxygen therapy is indicated in children when there is hypoxemia [18]. Kavitha K., *et al.* (2015) has mentioned that appearance of cyanosis is a late indicator of hypoxemia, so oxygen therapy should be started before appearance of cyanosis [7]. The initial seizure in eclampsia lasts for a minute or 2, so, it is important to maintain oxygenation by giving supplemental oxygen via a face mask, with or without an oxygen reservoir, at 8 to 10 liters per minute. This is important because hypoventilation and respiratory acidosis often occur during seizure. Once the seizure terminates and the patient resumes breathing, oxygenation is rarely a problem. However, maternal hypoxemia and acidosis can develop in women with repeated seizure, aspiration pneumonia, pulmonary edema, or a combination of these factors [19].

Responses of residents on statements: With respect to answers to questions related to “Oxygen Prescription”; more than 85% responded that oxygen flow rate or FIO_2 should be documented in the treatment (prescription) chart of a patient receiving oxygen rather than oxygen volume and oxygen diffusion rate, more than 81% responded that oxygen source and delivery device must be documented in the treatment (prescription) chart of a patient receiving oxygen rather than oxygen solubility and oxygen density, and more than 81% responded that frequency of administration should be documented in the treatment (prescription) chart of a patient receiving oxygen rather than oxygen odour and oxygen and nitrogen concentration. Regarding the statement on the prescription of oxygen and delivery, 40.7% believed that nasal catheter oxygen flow rate > 5 L/min lead to rebreathing of CO_2 is correct, 44.4% believed that oxygen prescription should be to a target saturation range rather than a fixed dose and 14.8% believed that oxygen concentrator delivers maximum oxygen concentration of 70%.

Evidence: The prescription must mention dose, method of delivery including device, stated arterial saturation target, duration of therapy and monitoring method [3]. The target saturations for acutely ill patient is between 94 - 98% but lower saturation target for patient with suspected risk of hypercapnia (Type II respiratory failure) i.e. between 88 - 92% [1,8,12,17].

Responses of residents on statements: Regarding residents reply to “Oxygen Delivery Practices” in a 72-year-old farmer with COPD has carbon dioxide retention (type II respiratory failure), 44.4% residents agreed that nasal catheter at 1 - 2 L/min/ in the absence of Venturi masks is the appropriate device for oxygen delivery to achieve a target saturation of 88 - 92%, 51.9% agreed that oxygen mask with reservoir 6 - 9 L/min, while 07.3% agreed on nasal catheter at 16 L/min. In a 12-year-old boy had type 1 respiratory failure to achieve a target saturation of 94-98%, 92.6% agreed that FiO_2 of 60% is correct, 07.4% for FiO_2 of 20% is correct while none for FiO_2 of 150%.

Evidence: Oxygen can be delivered via different devices e.g. Standard nasal cannulae (24 - 35% FiO₂ at a flow of 1 - 4 L/min), Simple face mask (40 - 60% FiO₂ at a flow of ≥ 5 L/min), Non-rebreather reservoir mask (> 60% FiO₂ at a flow of 15 L/min), Venturi masks (FiO₂ set at 24 - 60%), High-flow nasal cannulae (FiO₂ set at 21 - 80%) [9]. The target saturations for acutely ill patient is between 94 - 98% but lower saturation target between 88 - 92% for patient with suspected risk of hypercapnia (Type II respiratory failure) [1,8,12]. Once the patient has been stabilized, health professionals need to decide whether to continue therapy, when to titrate it or when to stop it altogether [8]. It is difficult to delimit exactly at what level of FIO₂ and duration of oxygen administration toxicity manifestations develop and surface. As per evidence pulmonary injury rarely occurs below an FIO₂ of 0.5, but atelectasis may occur at much lower level. The susceptibility to hyperoxic injury varies from person to person. Prolonged exposure (> 48 hours) to high (FIO₂ (> 0.5) may result in radiological and cellular changes in the lung like those of ARDS [16].

Responses of residents on statements: With respect to humidification is essential for patients receiving oxygen, 33.3% believed that endotracheal tube or a tracheostomy is appropriate, 07.4% nasal prong, while 51.9% in oxygen mask. Regarding weaning and discontinuation of oxygen, 92.6% believed that weaning and discontinuation of oxygen therapy should be started if clinically stable on low-dose oxygen, 07.4% on weaning and discontinuation of oxygen therapy should be commenced after a new chest radiograph is normal and none on weaning of oxygen therapy should be initiated if clinically stable on high-dose oxygen.

Evidence: Humidification is not needed for the delivery of low-flow oxygen via mask or nasal cannulae or for the short-term use of high-flow oxygen. In the emergency situation, humidified oxygen use can be confined to patients with tracheostomy or an artificial airway although these patients can be managed without humidification for short periods of time [20]. Oxygen therapy should be discontinued once a patient is clinically stable on low-concentration oxygen, and the oxygen saturation is within the desired range on two consecutive observations [20].

The major challenges identified by the participants were: inadequate knowledge of healthcare professionals regarding oxygen therapy, lack of training of healthcare professionals related to oxygen therapy, lack of resources, inadequate supply of equipments and oxygen, no central supply in wards, lack of periodic maintenance of equipment/devices, unavailability of standardized protocol for oxygen therapy in emergency, intensive care and wards, no practice for writing prescription for oxygen therapy, unclear and incomplete verbal order for oxygen therapy and patient don't have knowledge about oxygen therapy.

More or less similar challenges or reasons have been proposed regarding practices of supplemental oxygen therapy reported in literature [4,7,12,17,21].

Conclusion

This study shows that there is a gap in knowledge of residents about oxygen therapy, besides challenges identified by the residents in system. To raise awareness of the residents and other healthcare professionals (HCPs), educational programs related to oxygen therapy need to be organized and the programs must be included in continued medical education activities of the institution, so the HCPs remains updated. Also, there is need to identify the flaws in system and improve the system. The limitations of this study are small sample size, involving only one selected group of health professionals and conducted in one institution. The findings of this study cannot be generalized.

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Conflict of Interest

No conflict of interest.

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