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Effect of Educational Intervention on Oxygen Therapy Knowledge and Prescription Practices in an Inpatient Community Hospital: A Quality Improvement Initiative

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Abstract: Administering oxygen therapy is an essential part of managing and preventing hypoxemia in both acute and chronic conditions. It is important to note that administering excessive oxygen can also be harmful, particularly in patients with certain respiratory conditions. Therefore, oxygen therapy should always be prescribed and monitored by a healthcare professional. The aim of this quality improvement initiative is to determine the outcome of Education on Knowledge and practice of Oxygen therapy after 8 weeks of intervention. This cross-sectional study was carried out at the Metropolitan hospital center, New York, across the medical wards and intensive care unit (ICU) over a period of 12 weeks. A self-administered structured questionnaire was used to assess knowledge and practice related to oxygen therapy among resident doctors and nurses. Data from electronic prescribing record of all patients who received oxygen therapy over a period of 2 weeks was collected. After 8 weeks of education, questionnaires were distributed again to assess knowledge and practice of oxygen prescription. Data was also collected again from electronic prescribing record of all patients who required supplemental oxygen over a period of 2 weeks. Thirty-two resident doctors participated in this study pre and post educational intervention, while 9 nursing staff participated in the pre intervention phase. Knowledge of respiratory physiology was good (>80%) among resident doctors and nurses. On the average, knowledge of indications for oxygen supplementation was poor (55.5%) pre intervention and moderate (71.1%) post intervention. There was a statistically significant improvement (p value <0.0001) on the erroneous concept of oxygen as a treatment of breathlessness without hypoxia from preintervention (21.9%) to post intervention (75.0%). On the average, knowledge of the conditions in which oxygen saturation of >92% should be avoided was poor among resident doctors (57.3%) and nurses (40.8%) with some improvement post intervention (61%). Objectively, 56.5% of charts had documented oxygen prescription with significant improvement in documentation post intervention to 100% (p 0.0002). Documentation of target saturation in patients chart improved from 21.7% pre intervention to 48.0% post intervention although not statistically significant (0.059). About two-thirds of study participants (63.4%) have not received any training on oxygen supplementation in acute care setting within the past year. We concluded that knowledge of oxygen therapy and practice of oxygen therapy prescription and administration in our healthcare setting is suboptimal. Education improved prescription of supplemental oxygen in patients charts along with inclusion of target saturation.

Keywords: Oxygen Therapy, Oxygen Prescription, Hypoxemia, Respiratory Failure

1. Introduction

Hypoxemia can be caused by a variety of conditions such as pneumonia, asthma, chronic obstructive pulmonary disease (COPD), and heart failure, among others. Appropriate oxygen therapy plays a key role in the management of the patients with hypoxemia. Inappropriate and improper use of oxygen may lead to deleterious outcomes including hypercapnia, aspiration and pulmonary toxicity. According to the American Thoracic Society (ATS), liberal use of oxygen therapy in acute care setting did not provide mortality benefits with potential risk of harm from hyperoxia in various studies [1]. The British Thoracic Society (BTS) states that oxygen must be prescribed within desired target saturations of 94–98% and those at risk of hypercapnia should receive restrictive oxygen with a target saturation of 88–92% [2]. According to a meta-analysis, supplemental oxygen might become unbeneficial with saturation above 96% in acutely ill adults [3]. Therefore, medical and nursing staff need to be updated on best practice regarding oxygen therapy.

Professional bodies have recommended that oxygen therapy should be treated like other drugs, with documented orders included on a treatment chart to improve accurate administration. However, the prescription of oxygen therapy has been poor, and compliance with or adherence to the written prescription has not been consistently demonstrated [4]. In an observational study on supplemental oxygen delivery assessed in two medical units, only 90 of 206 patients (44%) were receiving oxygen as prescribed [5]. Studies have also demonstrated deficiencies in knowledge and skills relating to oxygen therapy including knowledge and application of oxygen delivery devices and pulse oximetry, among trainee doctors and nurses [6, 7].

There is scarcity of studies assessing the knowledge and practice of oxygen therapy among healthcare workers in New York city. Conducting local studies to assess the knowledge and practice of healthcare workers regarding oxygen therapy could help identify any gaps in knowledge or training and provide opportunities for education and training to improve the quality of care for patients. The results of such studies could also inform the development and implementation of standardized protocols for oxygen titration, as well as provide insights into how electronic monitoring systems can be used to track oxygen levels in patients receiving oxygen therapy. The aim of this study is to determine the effect of Education on knowledge of oxygen therapy and practice of oxygen prescription after 8 weeks of intervention. Specific objective of this study are as follows:

1. To assess knowledge of indications for acute oxygen therapy, target saturations and adverse effects of oxygen therapy after educational intervention.
2. To identify factors affecting appropriate use of oxygen therapy in acute care setting.
3. To improve prescription of supplemental oxygen in prescription charts and documentation of target saturations after educational intervention.

2. Methods

This is cross-sectional study was carried out on resident doctors and nursing staff of the Metropolitan hospital center, New York, across the medical wards and intensive care unit (ICU) over a period of 12 weeks. This project included 2 phases: pre and post intervention. The first phase involved distribution of self-administered questionnaires to internal medicine resident doctors to assess their knowledge and current practice of prescription of oxygen as a drug. Nurses also filled our questionnaire in the preintervention phase but did not participate in the post intervention phase. Data from electronic prescribing record of all patients admitted to the medical floors and ICU who received oxygen therapy over a period of 2 weeks was collected to objectively the proportion of patients who had appropriate oxygen prescription documented in their drug charts.

Thereafter, steps were taken to increase awareness among medical residents about the importance of appropriate oxygen prescription with inclusion of target saturations in patients' chart over an intervention period of 8 weeks. This was achieved by giving informational handouts (both in print and via email) and teaching sessions with small groups of residents. After 8 weeks of educational intervention, questionnaires were distributed again to assess knowledge and practice of oxygen prescription. Data was also collected again from electronic prescribing record of all patients admitted to the medical floor and ICU who required supplemental oxygen over a period of 2 weeks to see the effect of education on oxygen prescription documentation.

Assessment of knowledge according to blooms cut off points were categorized as good knowledge (80-100%), moderate knowledge (60-79%) and poor knowledge (≤ 59%). Practices were assessed using five Likert-item questions. Data were analyzed using descriptive statistics. Association between pre and post intervention variables were explored using Chi-square test with P value of less than 0.05 statistically significant.

3. Results

3.1. Demographic Characteristics of Participants

Thirty-two resident doctors participated in this study pre and post educational intervention, while 9 nursing staff participated in the pre intervention phase. Majority of the participants were in the 30–39-year bracket with 51% of the study participant females. Approximately 66% of the study participants admitted less than a month from the study period (Table 1).

Table 1. *Demographic and characteristics of all participants.*

Demographics	Number of participants (n=41)	
Age in years (n, %)	20-29	11 (26.8%)
	30-39	23 (56.1%)
	40-49	4 (9.8%)
	>50	3 (7.3%)
Gender (n, %)	Male	18 (43.9%)
	Female	23 (56.1%)
Profession (n, %)	PGY-1	11 (26.8%)
	PGY-2	10 (23.4%)
	PGY-3	11 (26.8%)
	RN	9 (22.0%)
Years of practicing medicine (n, %)	<2	10 (23.4%)
	2-5	12 (29.2%)
	6-9	10 (23.4%)
	>=10	9 (22.0%)
Experience in oxygen administration (In months, n, %)	<1	27 (65.8%)
	1-6	4 (9.7%)
	>6	10 (24.3%)

3.2. Knowledge of Respiratory Physiology, Target Saturation and Complications of Supplemental Oxygen Therapy

Knowledge of respiratory physiology was good (>80%) among resident doctors or nurses. Knowledge of target saturation for patients with hypercapnia was good among study participants while knowledge of target saturation in critically ill patients was moderate pre (65.7%) and post intervention (71.9%). On the average, knowledge of indications for oxygen supplementation was poor (55.5%) pre intervention and moderate (71.1%) post intervention. There was a statistically significant improvement (p value <0.0001) on the erroneous concept of oxygen as a treatment of breathlessness without hypoxia from (21.9%) preintervention to post intervention (75.0%). Knowledge of complication of hyperoxia was approximately 70% (moderate) pre and post intervention. On the average, conditions in which oxygen saturation of >92% should be avoided was poor among resident doctors (57.3%) and nurses (40.8%) with some improvement post intervention (61%). (Table 2)

Table 2. *Knowledge of Respiratory Physiology, Target saturation and complications of Supplemental Oxygen therapy.*

Respiratory Knowledge (% of participants that answered correctly)	Resident doctors (32)				Nurses (9)
	Pre intervention	Post intervention	Chi-square	P values	No intervention
Background knowledge of Respiratory physiology and target saturation					
Normal O_2 saturation at rest for adult <70 years	32 (100%)	32 (100%)	*	*	9 (100%)
Normal breathing rate in adult is 12-20 breaths/min	32 (100%)	32 (100%)	*	*	9 (100%)
Target oxygen saturation of patient at risk of hypercapnia is 88-92%	31 (96.9%)	31 (96.9%)	*	*	4 (44.4%)
Target oxygen saturation for critically ill patients 92-96%	21 (65.7%)	23 (71.9%)	0.282	0.595	7 (77.8%)
Clinical signs can suggest hypoxemia and hypercapnia	27 (84.4%)	28 (87.5%)	0.125	0.7233	9 (100%)
Blood gas analysis is useful for confirming hypoxemia	31 (96.9%)	32 (100) %	0.992	0.319	9 (100%)
Average percentage (Knowledge)	91.3% (Good)	92.7% (Good)	0.042	0.837	87.0% (Good)
Indications for oxygen therapy					
Asymptomatic anemia is indication for acute oxygen therapy ǂ	31 (96.9%)	31 (96.9%)	*	*	6 (66.7%)
Supplemental oxygen is indicated in all cases of MI ǂ	18 (56.3%)	17 (53.1%)	0.065	0.798	5 (55.6%)
Oxygen is a treatment for breathlessness without hypoxia ǂ	7 (21.9%)	24 (75.0%)	17.781	<0.0001	4 (44.4%)
Pre-oxygenation is required for endotracheal intubation in critically ill patients	15 (46.9%)	19 (59.4%)	0.988	0.320	7 (77.8%)
Average percentage (Knowledge)	55.5% (Poor)	71.1% (Moderate)	1.732	0.188	61.1% (Moderate)
Complications of hyperoxia					
Depression of ventilation and hypercapnia	26 (81.3%)	27 (84.4%)	0.107	0.744	7 (77.8%)
Absorption Atelectasis	17 (53.1%)	17 (53.1%)	*	*	6 (66.7%)
Pulmonary toxicity	28 (87.5%)	29 (90.6%)	0.155	0.693	9 (100%)
CNS toxicity	19 (59.4%)	20 (62.7%)	0.072	0.788	7 (77.8%)
Average percentage	70.3% (Moderate)	72.7 (Moderate)	0.045	0.832	80.6% (Good)
Conditions in which oxygen saturation greater than 92% should be avoided					
COPD	30 (93.8%)	31 (96.9%)	0.341	0.559	7 (77.8%)
Neuromuscular disorder	5 (15.6%)	6 (18.8%)	0.113	0.736	1 (11.1%)
Morbidly obese patients	14 (43.8%)	16 (50.0%)	0.243	0.622	0 (0%)
Bleomycin toxicity	11 (34.4%)	11 (34.4%)	*	*	3 (33.3%)
Acute severe asthma ǂ	27 (84.4%)	28 (87.5%)	0.125	0.723	6 (66.7%)
ARDS ǂ	23 (71.9%)	25 (78.1%)	0.323	0.569	5 (55.6%)

Respiratory Knowledge (% of participants that answered correctly)	Resident doctors (32)				Nurses (9)
	Pre intervention	Post intervention	Chi-square	P values	No intervention
Average percentage (knowledge)	57.3% (poor)	61.0% (moderate)	0.089	0.765	40.8% (Poor)

ł False statement
*No difference
ARDS: Adult Respiratory Distress Syndrome

3.3. Knowledge of Pulse Oximetry and Oxygen Delivery Devices

Knowledge of factors affecting pulse oximetry reading was poor (59.3%) pre-intervention among resident doctors compared with 66.7% among nurses. Knowledge increased to 63.9% post intervention among resident doctors, but difference was not statistically significant. Knowledge of indications for Continuous Positive Airway Pressure (CPAP) and Bilevel Positive Airway Pressure (BIPAP) also known as bilevel non-invasive ventilation was moderate pre (69.9%) and post intervention (72.4%) among resident doctors. Concerning contraindications to CPAP and bi-level ventilation, nurses had poor knowledge (51.9%) while resident doctors had moderate knowledge pre (72.4%) and post intervention (76.6%). (Table 3)

Table 3. *Knowledge of Pulse oximetry and oxygen delivery devices.*

Practice of oxygen therapy (% of participants answered correctly)	Resident Doctors (32)				Nurses (9)
	Pre Intervention	Post Intervention	Chi square	P values	No Intervention
	Factors that affect pulse oximetry reading				
Nail polish	27 (84.4%)	29 (90.6%)	0.554	0.456	9 (100%)
Severe anemia	25 (78.1%)	25 (78.1%)			6 (66.7%)
Cardiac arrhythmia	13 (40.6%)	16 (50.0%)	0.562	0.453	4 (44.4%)
Ambient light	5 (15.6%)	8 (25.0%)	0.860	0.353	4 (44.4%)
Motion artifact	27 (84.4%)	28 (87.5%)	0.125	0.723	8 (88.9%)
Blood pressure cuff on arm of probe	23 (71.9%)	23 (71.9%)	*	*	7 (77.8%)
AV fistula on arm probe ł	7 (21.9%)	8 (25.0%)	0.084	0.771	3 (33.3%)
Dirty probe	31 (96.9%)	31 (96.9%)			8 (88.9%)
Darkly pigmented skin	13 (40.6%)	16 (50.0%)	0.562	0.453	5 (55.6%)
Average percentage (Knowledge)	59.3% (Poor)	63.9% (Moderate)	0.141	0.707	66.7 (Moderate)
	Concerning nasal cannula				
Contraindications to use of nasal cannula (Knowledge)	77.8% (Moderate)	80.6% (Good)	0.075	0.784	66.7% (Moderate)
Concerning use of NIV (CPAP and BIPAP)					
CPAP indicated for hypoxemia due to cardiogenic pulmonary edema	26 (81.3%)	27 (84.4%)	0.107	0.744	8 (88.9%)
Increased work of breathing is indication for NIV	28 (87.5%)	29 (90.6%)	0.155	0.693	8 (88.9%)
Worsening Type 2 respiratory failure with acidosis is best treated with CPAP rather than BIPAP ł	12 (37.5%)	14 (43.8%)	0.259	0.610	3 (33.3%)
NIV may increase preload and blood pressure ł	20 (62.7%)	21 (65.7%)	0.062	0.803	3 (33.3%)
Improved oxygenation is achieved by increasing EPAP and FiO_2	28 (87.5%)	27 (84.4%)	0.125	0.723	7 (77.8%)
Reduced CO_2 is best achieved by reducing IPAP ł	20 (62.7%)	21 (65.7%)	0.062	0.803	5 (55.6%)
Average percentage (Knowledge)	69.9% (Moderate)	72.4% (Moderate)	0.048	0.826	62.9% (Moderate)
Contraindications to CPAP and BIPAP in clinical practice					
Pneumothorax	21 (65.7%)	23 (71.8%)	0.273	0.601	7 (77.8%)
Pneumomediastinum	20 (62.7%)	21 (65.7%)	0.062	0.803	6 (66.7%)
Bullous lung disease	18 (56.3%)	19 (59.4%)	0.062	0.803	5 (55.6%)
Inability to protect airway	29 (90.6%)	30 (93.8%)	0.224	0.635	5 (55.6%)
Rapid deterioration	23 (71.9%)	24 (75.0%)	0.078	0.780	2 (22.2%)
Severely Altered Mental Status	28 (87.5%)	30 (93.8%)	0.738	0.390	3 (33.3%)
Average percentage (Knowledge)	72.4% (Moderate)	76.6% (Moderate)	0.146	0.702	51.9% (Poor)

ł False statement
*No difference
NIV: Non invasive ventilation
CPAP: continuous positive airway pressure
BIPAP: bilevel positive airway pressure
Fi02: fraction of inspired oxygen
IPAP: Inspiratory positive airway pressure
EPAP: Expiratory positive airway pressure

3.4. Practice of Oxygen Documentation in Patients Charts Pre and Post Intervention

About 42 percent of study participants believe that oxygen prescription is documented in patients' chart all the time while 58% percent documents target saturation all the time. Objectively, 56.5% of charts had documented oxygen prescription with significant improvement in documentation

post intervention to 100% (p 0.0002). Documentation of target saturation in patients chart improved from 21.7% pre intervention to 48.0% post intervention although not statistically significant (0.059). (Table 4)

Table 4. *Documentation of oxygen prescription in charts.*

Subjective documentation of oxygen prescription					
Total n=41	**All of the time**	**Most of the time**	**Some of the time**	**Rarely**	**Not at all**
All patients receiving supplemental oxygen have a documented prescription in patients Chart	17 (41.5%)	16 (39%)	7 (17.1%)	1 (2.4%)	0
The following are included in oxygen prescription					
Indication for oxygen therapy	20 (48.8%)	13 (31.7%)	6 (14.6%)	1 (2.4%)	1 (2.4%)
Target Saturation	24 (58.5%)	7 (17.1%)	4 (9.7%)	4 (9.7%)	2 (4.9%)

Objective documentation of supplemental oxygen order pre and post intervention				
	Pre intervention (n=23)	**Post intervention (n=25)**	**Chi-square**	**P value**
Documented prescription in patients Chart orders	13 (56.5%)	25 (100%)	13.452	0.0002
Target Saturation documented	5 (21.7%)	12 (48.0%)	3.548	0.059

3.5. Factors Influencing Oxygen Prescription Practices

About two-thirds of study participants (63.4%) have not received any training on oxygen supplementation in acute care setting within the past year. Seventy-three percent of participants do not know if supplemental oxygen is included in medical bills. About half of study participants (51.2%) believe that workload does not affect oxygen documentation practices while the majority (90.3%) agree that there is enough supply of oxygen delivery on the floors. (Table 5)

Table 5. *Factors affecting oxygen supplementation practices in acute care setting.*

Factors	**Yes**	**No**	**I do not know**
Have you trained on oxygen therapy/administration in the last 1 year?	15 (36.6%)	26 (63.4%)	0 (0%)
Is there a guideline of oxygen therapy in the currently in your ward/unit?	9 (22.9%)	15 (36.6%)	10 (41.5%)
Is there adequate supply of oxygen and delivery systems in your unit?	37 (90.3%)	3 (7.3%)	1 (2.4%)
Do you know if your patient's administered oxygen, paid/charged for the procedure?	8 (19.5%)	3 (7.3%)	30 (73.2%)
Do you think workload/ burden affects oxygen therapy practice in your unit?	14 (34.1%)	21 (51.2%)	6 (14.6%)

4. Discussion

Oxygen supplementation is often routinely administered to patients in acute care settings, even in the absence of clear indications. The practice of inappropriate or excessive use of oxygen supplementation has potentially detrimental adverse effects [8]. Our study evaluated the effectiveness of educational intervention in improving healthcare providers' understanding of oxygen therapy and their ability to appropriately prescribe oxygen to patients, which could ultimately improve patient outcomes.

This study showed that basic knowledge of respiratory physiology and target saturation for most acutely ill patient and patients at risk of hypercapnic respiratory failure was good. Knowledge of indications for supplemental oxygen was poor pre-intervention for resident doctors, in contrast to nurses who had moderate knowledge. Post intervention, there was improvement in knowledge although not statistically significant. There was a significant improvement in the awareness that not all patients presenting with breathless requires supplemental oxygen except when there is hypoxia ($p < 0.0001$). Interestingly, more than 50% of respondents agreed that all patients with myocardial infarction (MI) should receive supplemental oxygen. Although still a matter of debate, there are concerns that hyperoxia may induce coronary vasoconstriction, worsening myocardial necrosis in patients with MI [9-11]. A randomized controlled study of 6629 patients with acute MI concluded that routine use of supplemental oxygen in MI did not reduce 1-year all-cause mortality [12]. Recent guidelines strongly recommend against using oxygen therapy in patients with cardiac ischemia without hypoxia [13].

Regarding complication of hyperoxia in general, resident doctors had moderate knowledge pre and most intervention while nurses had good knowledge. Both resident doctors and nurses had good knowledge that hyperoxia may induce hypercapnia. Oxygen induced hypercapnia has been studied in patients with chronic obstructive pulmonary disease (COPD). Although liberal use of oxygen therapy may temporarily decrease minute ventilation, the main mechanism by which oxygen induces hypercapnia is reversal of hypoxia induced vasoconstriction in damaged alveoli with low oxygen tension leading to increased alveolar dead space ventilation [14]. A study of 405 patients with acute COPD exacerbation found that titrating oxygen treatment significantly reduced mortality, hypercapnia, and respiratory acidosis in contrast to those who received high flow oxygen [15]. Central nervous system toxicity due hyperoxia was answered correctly by approximately 63% of residents pre intervention without significant improvement post intervention and 78% of the nurses. Studies have shown that supplemental oxygen in non-hypoxic patients with acute stroke did not improve favorable outcomes and may be

detrimental in patients with traumatic brain injury [16, 17]. Therefore, in acutely ill patients with cardiac arrest, traumatic brain injury, stroke, and sepsis, liberal oxygen therapy when not indicated may lead to hyperoxemia and adverse outcomes [18]. Despite documented adverse effects of hyperoxia, there is an observed trend of excessive oxygen tension among patients on supplemental oxygen with proportions ranging between 30-60% [19-21].

Resident doctors and nurses have poor knowledge of disease condition in which oxygen excessive oxygen supplementation with target saturation of greater than 92% should be avoided. Except for COPD, most were unaware of other disease conditions at risk of oxygen induced hypercapnia such as morbid obesity and neuromuscular diseases [2]. Most respondents answered that patients with bleomycin induced lung injury should have target saturations above 92%, while patients with acute respiratory distress syndrome (ARDS) should have saturation targets below 92%. According to guidelines, bleomycin lung injury may be harmed by supplemental oxygen and should be avoided unless the patient is hypoxemic with target saturation is 85–88 [2, 22]. Regarding ARDS, pending the outcome of further studies, a high fraction of inspired oxygen is required, especially early in ARDS when pulmonary edema is most severe with recommended target saturation range for acutely ill patients not at risk of hypercapnic respiratory failure is 94–96% [2, 23].

Knowledge of factors affecting pulse oximetry readings such as darkly pigmented skin and ambient light was poor pre intervention for resident doctors with some improvement in knowledge post intervention. Nurses had moderate knowledge of factors affecting pulse oximetry readings. A study of 30 trainee doctors and nurses revealed that 97% of the study participants did not understand the principles of pulse oximetry and factors affecting its use [7]. With regards to non-invasive ventilation (NIV), knowledge of indications and contraindications to NIV was moderate pre and post intervention. Both resident doctors and nurses had poor knowledge regarding the choice between continuous positive airway pressure (CPAP) and bilevel positive airway pressure (BIPAP) for patients with type 2 respiratory failure. Current guidelines recommend BIPAP when the pH is $\leq$7.35, P_{aCO2} is >45 mmHg and tachypnea despite standard medical therapy [24, 25]. Our study participants lacked knowledge of the fundamental principles guiding the use of CPAP and BIPAP. This result is not surprising, as CPAP and BIPAP are advanced respiratory support therapies that require specialized training and expertise to use properly. A review article by Reazaul et al, noted lack of training on use of NIV among health care workers with poor patient outcomes [26].

Oxygen was prescribed in patients' chart in greater than 50% of patients on supplemental oxygen in our study. This observation contrasts another study in which only 8% of patients on oxygen therapy had a prescription in their medication chart, in keeping with a general trend of poor oxygen prescription practices in literature [27, 4]. Documentation of target saturation was 22% in our study. Other observational studies have also documented poor oxygen prescription practices with target saturation documented in less than 40% of cases [28, 29]. Our intervention significantly improved prescription of oxygen therapy in patients charts from 57% pre intervention to 100% post intervention. Documentation of target saturations in patients' charts also improved pre and post intervention from approximately 22% to 47% although not statistically significant. Another study documented overall improvement in prescription rate from 24% to 95% while the rate of prescription with correct target saturations improved from 14% to 66% with educational intervention [29]. There was a gap between perceived practice and objective practice of oxygen prescription in patients' charts. Majority of respondents answered that oxygen prescription including target saturation were included in patients' chart all the time, underscoring the need for objective and verifiable data in identifying current practices.

Our study also showed that workload does not affect oxygen supplementation practices and most resident doctors and nurses agreed that there is enough supply of oxygen delivery system in every ward and ICU. Most resident doctors and nurses are not aware that documentation of hypoxia in patients chart impacts reimbursement for patient care. Majority of the respondents are also not aware of guidelines for oxygen therapy in the hospital and did not receive any form of training on oxygen administration in the past year. These are factors that may be contributing to the inadequate knowledge and practice of oxygen therapy in the medicine inpatient services. Review of literature consistently demonstrated that inadequate training and education for medical and nursing staff, a lack of familiarity with oxygen delivery devices, a lack of understanding of adverse of oxygen therapy, staff time constraints and workload, unwillingness to change established behavior, poor communication between doctors and nurses and lack of local guidelines as reasons for poor oxygen prescription practices [4, 30].

Different interventions in various combinations have been employed to improve oxygen prescription practices in inpatient settings. One important measure is the development and implementation of oxygen titration protocols. These protocols provide guidelines for healthcare providers on how to adjust oxygen flow rates and monitor oxygen levels to ensure that patients receive the appropriate amount of oxygen. Another important measure is the implementation of healthcare education programs that provide training on the appropriate use of oxygen therapy. Although our intervention led to some improvements in the practice of oxygen prescription, it did not significantly improve knowledge overall regarding the indication, target saturation in specific disease conditions and adverse effects of hyperoxia. Multiple cycles of intervention may be needed to improve knowledge and current practice of oxygen supplementation [29, 31]. The lack of guidelines on oxygen supplementation in acute care settings can be a significant factor contributing to inadequate knowledge and practices among healthcare providers. This can lead to inappropriate or ineffective use of oxygen therapy, which may result in adverse outcomes for patients

and substantial waste in health care spending [32]. Therefore, providing guidelines for oxygen supplementation in each ward and making them readily accessible can help to improve oxygen prescription practices in acute care settings.

5. Conclusion

To summarize, basic knowledge of respiratory physiology and target saturation for most acutely ill patients and patients at risk of hypercapnic respiratory failure was good. However, knowledge of saturation targets in various disease conditions and non-invasive ventilation was poor to moderate respectively. There was no improvement in the knowledge of noninvasive ventilation, indications for oxygen therapy and conditions in which hyperoxia should be avoided post intervention. However, our intervention improved prescription of supplemental oxygen in patients charts as well as inclusion of target saturation. Potential factors contributing to suboptimal oxygen therapy practices include inadequate knowledge of principles governing oxygen supplementation, lack of readily available guidelines as well as training on oxygen supplementation in acute care settings. Combination of measures such as oxygen titration protocols, and healthcare education programs are important in improving oxygen prescription practices.

List of Abbreviations

ATS: American Thoracic Society
ARDS: Adult Respiratory Distress Syndrome
BTS: British Thoracic Society
COPD: Chronic Obstructive Pulmonary Disease
CPAP: Continuous Positive Airway Pressure
BIPAP: Bilevel Positive Airway Pressure
ICU: Intensive Care Unit

Ethics Approval and Consent to Participate

This Quality improvement project was approved by the Head of department of Medicine and Program Director of NYMC-Metropolitan Hospital Center.

Availability of Data and Materials

Uploaded as a separate file

Competing Interests

All the authors do not have any possible conflicts of interest.

Authors' Contributions

Adebola O Adetiloye, Farhana Alladin, Abida Naz, Kuldeep Ghosh, Armeen Poor Prepared the manuscript.

Adebola O Adetiloye, Kuldeep Ghosh and Armeen Poor prepared the Tables.

All authors reviewed the manuscript.

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