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Acute Oxygen Therapy: An Audit of Prescribing and Delivery Practices in the Medical Wards at Dr. George Mukhari Academic Hospital, Pretoria, Gauteng

E. A. Akazie, M. J. Mpe

Sefako-Makgathu Health Sciences University, Ga-Rankuwa, South Africa
Email: john.mpe@smu.ac.za

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Abstract

Background: Oxygen is a commonly used drug in modern medical care. It has biochemical actions, safe dosage ranges, adverse physiologic effects and can be toxic at high doses and prolonged use. As a drug, it needs a formal prescription prior to administration. The prescription needs to meet certain basic minimums for appropriateness and safety. **Objectives:** The aim of the study was to assess the standards of prescriptions for oxygen therapy amongst admitted medical patients at the Dr. George Mukhari Academic Hospital. **Materials and Methods:** It was a cross-sectional study of 159 acutely ill medical admissions who received supplemental oxygen. The medication charts of patients on oxygen were audited; with regards to the availability and/or adequacy of the prescription for oxygen. **Results:** Of the one hundred and fifty nine patients on oxygen only 43 (27%) had an actual prescription for oxygen written. The target oxygen saturation was specified in 19 (44%) cases. The device for oxygen delivery was specified in 21 (49%) patients and just over half of the patients (56%) had flow rates indicated on their charts. **Conclusion:** The practice of oxygen administration in our medical wards was sub-optimal. The audit highlights the need for education and training in acute oxygen therapy.

Keywords

Oxygen, Targets, Devices, Flow Rates

1. Introduction

Oxygen is a commonly used drug in modern medical care. It has biochemical

and physiologic actions, safe dosage ranges, adverse physiologic effects and can be toxic with high doses and prolonged use [1]. As a drug, like all other medication, it needs to be administered with as much care. Oxygen supplementation aims to ensure that sufficient oxygen is provided at tissue level to meet metabolic demand.

It is estimated that approximately 34% of ambulance patients receive oxygen during transit and that 15% - 17% of hospital inpatients will be on oxygen at any given time [2] [3]. For critically ill patients with hypoxemia provision of supplemental oxygen is first-line therapy [4].

When used judiciously it saves lives [5]. Oxygen is, however, often used inappropriately and the dangers of over-oxygenation are under-appreciated [6] [7]. Used improperly, oxygen can lead to significant adverse effects [5].

Audits of oxygen use and oxygen prescription have shown consistently poor performance in many countries [3] [8]. Although it is regarded as a drug, oxygen is often given to patients without a physician's order [9]. In cases where the order has been done, the prescriptions have tended not to meet certain basic minimums for appropriateness and safety [10] [11]. These basic minimums required on a prescription for oxygen are: the desired target saturation or range thereof, a set flow rate and an indication of the desired device to be used to administer oxygen [2].

Setting the target oxygen saturation helps ensure the oxygen delivered is adequate for the clinical setting and avoids over oxygenation which could be harmful in other clinical situations. The settings also allow for the staff to escalate or de-escalate oxygen therapy as appropriate. Setting of flow rates and indicating the device necessary avoids improper flows being used on the particular device which could lead to patient harm; including death in some circumstances [6].

2. Aim

The aim of this study was to assess the appropriateness of oxygen prescriptions and delivery practices in the medical wards of Dr. George Mukhari Academic Hospital.

2.1. Study Objectives

1) To determine the proportion of patients on oxygen for which a script has been written out.

2) To ascertain the presence of a script for oxygen among patients on oxygen.

3) To determine the adequacy of oxygen prescriptions where available. An adequate script was one that indicated: saturation target, delivery device and flow rate.

2.2. Patients and Methods

The study was conducted on the medical wards of DGMAH, a tertiary health care centre. Permission to conduct the study had been granted by the Sefa-

ko-Makgatho University Research Ethics Committee; reference number SMUREC/M/160/2020:PG.

It was a cross-sectional study of consecutive newly admitted adult medical patients (18 years and over), who had been on oxygen therapy for an acute illness, for at least 24 hours. The study took place over an 8-week period (September-October 2020). Patients were enrolled into the study after informed consent had been obtained. The following information was obtained from the records and transcribed onto a data collection tool: demographics, underlying diagnosis, indications for oxygen therapy, availability of the prescription for oxygen, and completeness of the prescription. A prescription was considered complete if the following were indicated on the script: target saturation, delivery device and flow rate. Patients on long-term oxygen therapy and those on non-invasive ventilatory support were excluded.

2.3. Sample Size Calculation

Formal prescription by physicians for the use of oxygen therapy had been reported to vary quite widely, anywhere between 43.5% and 82.0%. We assumed that the rate of formal prescription for oxygen therapy in DGMAH fell within this wide range and was 63%. With error limit of 5.0% and 85% power of the study, a statistically derived sample size of 159 patients was arrived at.

2.4. Data Analysis

Data from the study was transcribed from the data collection forms into Microsoft "Excel" software programme and analysed using the Statistical Package for Social Sciences (SPSS, IBM, USA). Categorical variables were summed up as percentages and non-categorical variables were summarised as means ± SD.

3. Results

A total of one hundred and fifty-nine patients, 18 years and above, were studied. The mean age of the group was 51.2 ± 16.3 years. 42.1% of the patients were female. The study was conducted over a 2-month period.

All patients had been on oxygen for at least 24 hours. The twenty-four grace period was given to allow time for scripts to be written, especially in those cases where oxygen was started as a matter of urgency. The baseline oxygen saturations of the patients ranged from 74% to 95% with a mean of 85% ± 4%. Vital signs observations were done a mean of 3.9 ± 0.5 hours.

The majority of the admissions (64.2%) were for community-acquired pneumonia. Exacerbation of chronic obstructive pulmonary disease and interstitial lung disease accounted for a minority of the admissions (1.9% each). **Table 1** is a summary of the patients' admission diagnoses.

A total of 43 patients (27%) had a written oxygen prescription in their charts. The target oxygen saturation was specified in only 19 (44%) of these. **Figure 1** is

Table 1. Admission diagnoses.

Diagnosis	Frequency
Pneumonia	102 (64.2%)
Congestive heart failure	12 (18%)
Pulmonary embolism	5 (3.1%)
Sepsis	5 (3.1%)
Liver failure	5 (3.1%)
Pleural effusion	5 (3.1%)
Para-suicide	5 (3.1%)
Acute coronary syndrome	4 (2.5%)
Diabetic keto-acidosis	4 (2.5%)

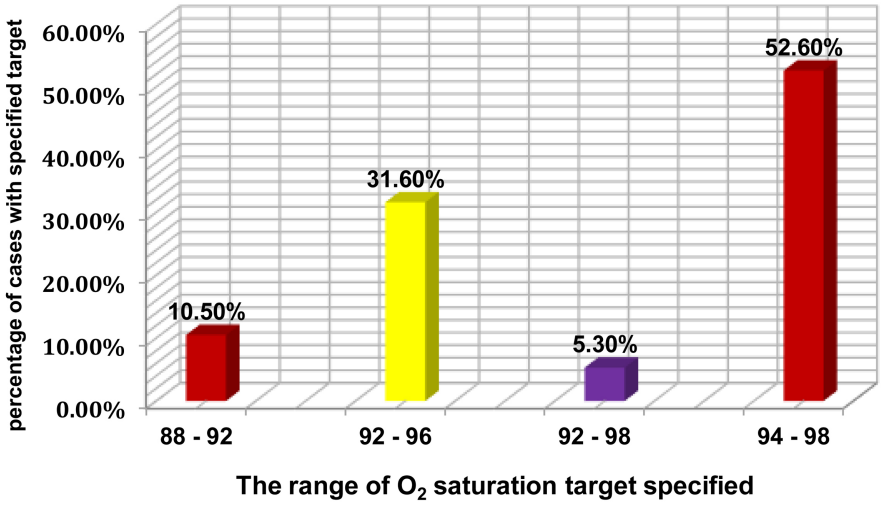

Figure 1. An illustration of the target saturations specified.

an illustration of the target saturations specified.

Twenty four patients (56%) had the flow rates appropriate for the device being used charted. Twenty one patients (49%) had the oxygen delivery equipment specified on their charts. A partial rebreather mask was used in 91 patients (57.20%). The next commonest delivery device was nasal prongs, used in 34% of the cases. Figure 2 is a summary of the other oxygen delivery devices utilized.

4. Discussion

The percentage of patients on oxygen with a prescription in this study was low at only 27%. This seems to be have been the trend in audits around the world. In an observational study of the practice of oxygen prescription and administration in a hospital in Saudi Arabia, written prescriptions were available in only 13% of the charts of the cases that were on oxygen [12]. During a pre-education audit carried out on 55 patients on oxygen on a respiratory ward in England, the researcher found only 5% of patients had a prescription [13]. In Boyle and Wong's

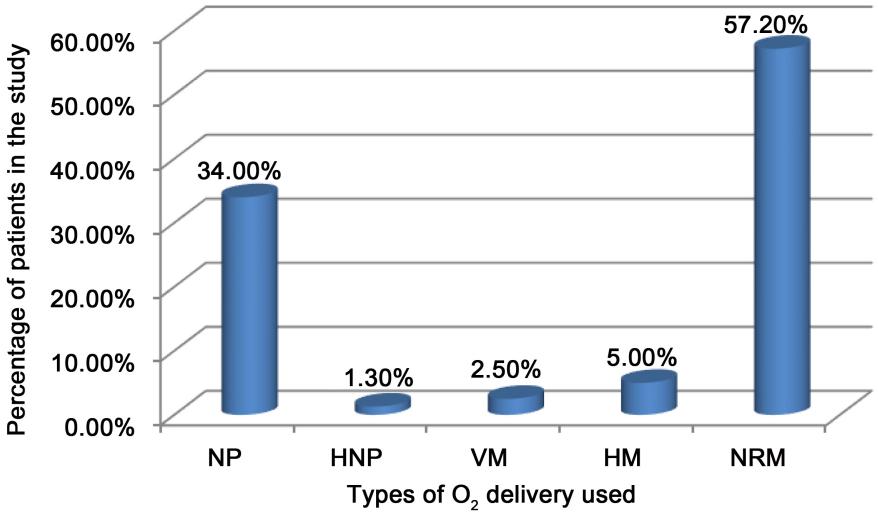

Figure 2. Key: NP = Nasal prongs; HNP = High flow nasal prongs; VM = Venturi mask; HM = Hudson mask & NRM = Non-rebreather mask.

audit of a New Zealand hospital only 8% of patients receiving oxygen had it prescribed in their medication chart [14]. A survey assessing knowledge, attitudes and practice of oxygen administration, found that 13% of the doctors and nurses reported to never prescribe oxygen [15]. Only a recent study by Hutchinson and colleagues seems to have been the exception. Oxygen was prescribed in 63% of those on oxygen [16].

The BTS guide on oxygen therapy advises that oxygen can be provided without a written script when needed in an emergency situation [2]. The clinicians are, however, expected to follow this up with a written record.

The range of the patients' base-line oxygen saturations in this study (74% - 95%) suggests that some patients were commenced on oxygen therapy despite normal saturations. The likely explanation for this was not looked at closely; our conjecture is that these patients may have been given oxygen for respiratory distress or breathlessness, which are not always accompanied by hypoxemia.

The target oxygen saturation was specified in 44% of the patients. According to guidelines, an oxygen target saturation range should be prescribed for all patients who are admitted to hospital to mitigate the dangers of hyperoxia [2]. Kamran and colleagues found a compliance rate of 55% in this aspect of oxygen therapy at the Royal Perth Hospital. This rate was up to 95% in an academic hospital in Telford, England [16].

The prescribed target oxygen saturations in this study were random and varied. We did not focus on the appropriateness of the target saturations for the underlying conditions. It is important to take this into consideration as inappropriate targets can be harmful. According to the BTS guidelines oxygen should be prescribed to achieve a target range that is patient specific: a saturation of 94% - 98% for the majority of acutely ill patients or 88% - 92% for those at risk of hypercapnoeic respiratory failure [2]. Kamran's group in Australia assessed

the written targets to be inappropriate in 25% of their cases. Szulc and colleagues presented a poster at the ERS congress of 2012 where in the target oxygen saturations of the study population was found correctly specified in only 23% of the cases [17].

The percentages of patients for whom the oxygen delivery device and flow rates were specified were low at 49% and 56% respectively. It is equally important to specify the device and flow rates. Inappropriate flow rates for specific devices have the potential for harm. An example would be inappropriately low flow rates on a non-rebreather mask, with the potential to suffocate a patient. The BTS guide recommends that appropriate devices and flow rates are used in order to achieve the target saturation range and that those involved with oxygen administration are trained in the use of available oxygen delivery devices to ensure safe oxygen delivery [2]. It should not be assumed that all health care workers are familiar with oxygen delivery devices and their appropriate flow rates. A study conducted among nurses in Ethiopia found evidence of clear gaps in the knowledge and practice of administration of supplemental oxygen amongst them [15]. Aloushan and co-workers found worrying gaps in the knowledge, attitudes and practice of emergency health care workers regarding the use of oxygen therapy in the acute setting [18].

5. Conclusions

The audit highlights significant gaps in the standard of prescriptions for oxygen therapy in the acute setting in our hospital and the need for physician and nurse re-education programs on acute oxygen therapy. Some authors have suggested that this is a reflection of poor knowledge, attitudes and practice of the staff involved with administration of this medication and recommend extensive educational and training programmes for health care workers who deal regularly with oxygen administration and that the programmes need regular re-enforcement [15] [18] [19]. In addition, lack of local supplemental oxygen administration standard guidelines may have played a role. Development of national and hospital guidelines in this regard is recommended.

Study strengths were the prospective nature of the study and the inclusion of an unselected cross-sectional cohort of patients. The weakness of our study is that it is a single centre study and generalization to other inpatient settings may be limited.

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Author Contributions

Protocol development: Akazie 60%; Mpe 40%; Manuscript write-up: Akazie 50%; Mpe (50%).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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