Oxygen therapy audit in two medical wards

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Abstract

Oxygen therapy is the mainstay of treatment in acute respiratory failure. Several works have shown the correct procedure is seldom performed. We carried out an audit to identify a faulty practice and to plan strategies to provide the best care.

The audit was performed in the first quarter of 2008. All patients to whom oxygen was administered or prescribed were included. All the process of oxygen therapy, from medical prescription through nursing transcription, administration and medical and nursing monitoring, had to be in accordance with the recommendations of "Guideline for emergency oxygen use in adult patients: Summary of draft guideline" by the British Thoracic Society. The administration of oxygen while patients were transported, having meals, in hygiene and using humidifiers was also audited.

A total of 472 episodes of oxygen therapy were audited, corresponding to 178 patients. There was a medical prescription of oxygen in 97.7% of the audited episodes. A complete "fixed dose" oxygen prescription was present in only 51.2%. Just 51.1% episodes of oxygen administration fully respected the transcription. Monitoring was the same as transcribed in 86.7% episodes.

Oxygen therapy, although being a common treatment in most hospitals for acute conditions, is not implemented according to international recommendations of care. There are practices to improve in oxygen prescription, transcription, administration and monitoring. Clinical audit is an excellent tool to recognizing and improving the quality of delivering oxygen therapy.

Key words: oxygen therapy, clinical audit.

INTRODUCTION

Oxygen therapy is crucial for the treatment of respiratory failure. Its use in hospital for acute patients is a routine procedure,[1] particularly in medical wards, representing one of the most prescribed medications. Several works demonstrate that oxygen therapy, from the prescription to the administration is used inadequately.[1-6]

In spite of being considered by many as harmless, oxygen must be faced as any other medication with indications, dose, administration methods and specific monitoring. For a long time that hypoxia and hyperoxia consequences are recorded in hypercapnic respiratory failure, but it is verified a growing evidence of side effects due to hyperoxia on respiratory physiology, myocardial ischaemia, cerebral infarctions and childbirths, reinforcing the need for a more precise control on the amount of oxygen delivered.[1,7]

Until the publication of the Guideline for emergency oxygen use in adult patients by the British Thoracic Society,[1] there were scarce international publications approaching specifically oxygen therapy.[5,8] Simultaneously it is scarce the scientific literature about oxygen therapy procedures,[1,7] particularly if it is considered its widespread use. All this contributes for an incorrect practice.

Recognizing the need to improve oxygen therapy procedures and benefiting from the publication of guidelines of consensus defining the state-of-the-art, the authors carried out a clinical audit to identify incorrect practices and planning the strategies for optimizing procedures.

METHODS

A working group, made up by physicians and nurses was created during 2007 to evaluate oxygen therapy practice in two wards of Internal Medicine at St. Antonio Hospital, Porto Hospital Center – Portugal. The evaluated wards had 46 beds and a nurse/patient ratio changing between shifts: 1:5 in the morning, 1:7 in the afternoon and 1:8 in the evening.

It was carried out a review of literature on guidelines, auditing and procedures of oxygen therapy in acute inpatients. It was designed a clinical audit to evaluate all the oxygen therapy procedures, from the medical prescription to the transcription, administration and monitoring both by physicians and nurses comparing the current practice with the recommendations of the Guideline for Emergency Oxygen Use in Adult Patients: Summary of Draft Guidelines From

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The British Thoracic Society.[9]

The auditing was carried out from the 1st January to the 31st March 2008. Two days were chosen per week, from Tuesday to Friday, to audit oxygen therapy procedures in both wards. Mondays, holidays and days after bank holidays as well as patients admitted in the last 24 hours were excluded to ensure that all oxygen prescriptions were carried out or validated by ward physicians. Health professionals were not aware of the day selected for the auditing.

All the patients to whom it was delivered or prescribed oxygen were included in the auditing. The same patient could be included in different days of auditing if he/she met the inclusion criteria. Patients with oxygen therapy through non-invasive ventilation, during the day (the period to administer oxygen was complied with) were excluded.

The criteria to prescribe oxygen demanded a clearly defined medical order in the right place of the patient's clinical file, defining the system to administering oxygen, debit or inspired fraction (FiO_2), during the monitoring and of saturation of oxygen ($SatO_2$).[1,2,10,11] The prescription to correct the $SatO_2$ interval was also considered correct if appropriate for the kind of respiratory insufficiency.[9] Such information was audited by a consultation of the patient's clinical file.

The criteria to the nursing transcription required this to be a precise copy of the medical prescription. Such information was audited by consulting the nursing computing application.

The administration criteria implied that each point of the nursing plan was complied with according to the previous transcription of the medical prescription. If the restriction of oxygen was according the prescription by the nurse, both different from the medical prescription (transcription error), the administration was considered correct. Such information was gathered observing patients directly.

The duration of oxygen delivery was not audited as it was impossible to the auditing team to ensure a 24 hours monitoring on patients.

The use of humidifiers was also audited. It was considered that any humidifier should be used when it was prescribed by the physician, when the oxygen output was over 4 L/minute or when this was administered by tracheostomy.[1,10] It was assumed that the validity of each humidifier was 72 hours[12] and the water levels should be in accordance with the manufacturer's specifications.

The oxygen administration during the patient's transport, meals and hygiene was considered correct when it was the same as the ward. The administration during transport was evaluated when leaving the ward to ensure that only wards professionals were audited.

The monitoring criteria demanded that it was performed in accordance with the nursing transcript. Such information was audited consulting the nursing records. It was also considered that every patient to whom oxygen was delivered should have an arterial gasometry evaluation daily and a continuous monitoring of $SatO_2$.[3,9,10] Such data was gathered from the patient's clinical file and the nursing records.

According to literature, the avoidable medical error is frequent in particular during the drugs prescription.[13] A study on medication prescription errors in an intensive care unit, comparing the prescription in paper with the electronic one has verified the incidence of prescription errors ranging from 27 to 3.4% respectively.[14] Considering such study, the authors defined that in each oxygen therapy procedure the criteria of clinical audit for a good practice was reached every time the compliance rate was equal or above 90%.

All these endpoints have as set back that all oxygen therapy procedures carried out by the auditing team members were also included in the evaluation.

All the data was recorded in a data base and assessed by SPSS 11.0

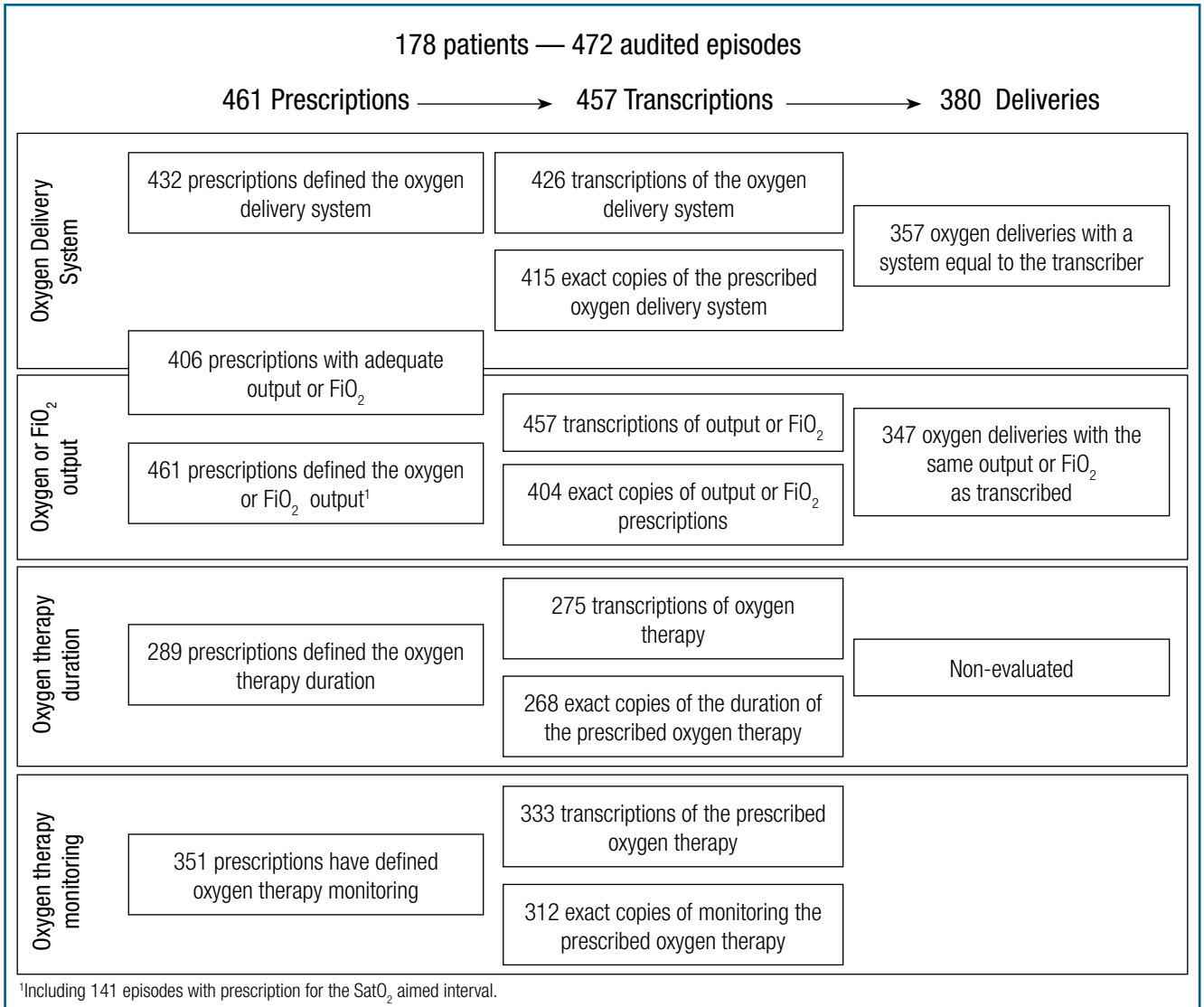
RESULTS

472 episodes of oxygen therapy, corresponding to 178 patients were audited. The gender female: male ratio was 1:1.04 and the average age of 71.8 years (*Fig. 1*).

The main indication for oxygen therapy, responsible for 85.6% of audited episodes, was an acute respiratory insufficiency whether new, whether as a complication of a chronic respiratory insufficiency. Stable chronic respiratory insufficiency, sepsis, pneumothorax, severe anemia and acute coronary syndrome were the other indications found. In 6.6% of episodes there was not a clear indication for oxygen therapy in the patient's clinical file.

PRESCRIPTION

There was a medical prescription for oxygen in 97.7% of the audited episodes. In all of them was defined FiO_2 or the output, but the delivery system was only



[1]Including 141 episodes with prescription for the $SatO_2$ aimed interval.

Results.

FIG. 1

determined in 93.7%. From these, prescribed the output or FiO_2 were appropriate to the delivery system in 94% of episodes. The prescription was aiming a $SatO_2$ interval in 30.6% of episodes. From this, in 109 episodes it was possible to identify the kind of respiratory insufficiency, being the $SatO_2$ target range appropriate in 57.8%. The oxygen therapy duration was prescribed in 32.1% of episodes and implied in prescriptions with an interval target of $SatO_2$. In general we can consider that the duration was prescribed in 62.7% of episodes.

Monitoring oxygen saturation was prescribed in 76.1% of the audited episodes. In two episodes there was no monitoring because patients were under palliative care.

A complete "fixed dose" prescription, i.e., defining the oxygen delivery system, output or FiO_2 appropriate for the delivery system, duration and monitoring of oxygen therapy, was present in only 51.2% of prescriptions (*Fig. 2*).

TRANSCRIPTION

In 461 prescriptions, 99.1% were transcribed by the nursing staff to the IT application. Seven oxygen therapy prescriptions were found without medical prescription. When assessed separately, each prescription

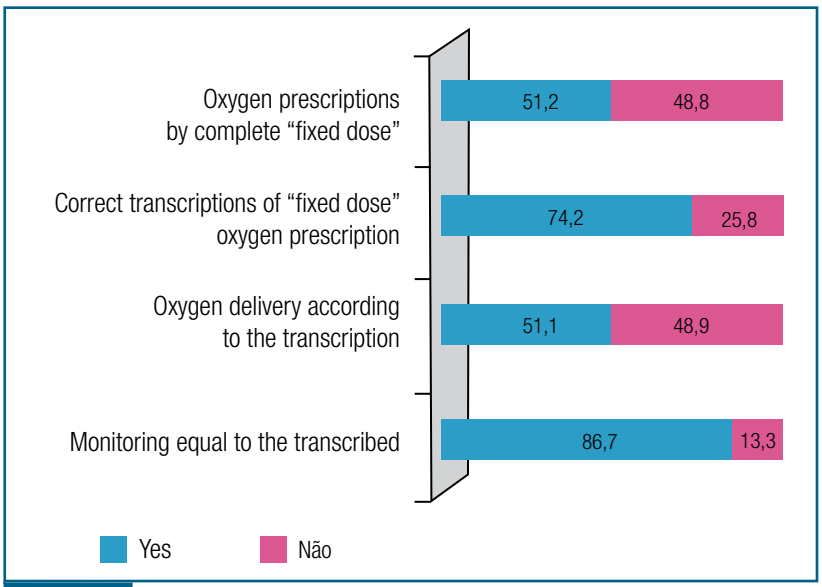


FIG. 2

item (administration system, output or FiO_2, duration and monitoring) was transcribed in 95% or more of those episodes. Assessing the transcription error, the administration system transcribed was the same that the one prescribed in 97.4% of episodes, output or FiO_2 in 88.4%, duration in 97.5% and monitoring in 93.7%. Considering all parameters of oxygen therapy in simultaneous, only 74.2% of 236 episodes only 10 have an oxygen prescription for "fixed dose" and exact transcription. (*Fig. 2*).

DELIVERY

Oxygen delivery was audited in a universe of 457 episodes with prescription and transcription. In 94.7% of episodes, oxygen was delivered or attempted to, (non-delivered oxygen because it was not necessary to reach the aimed interval of oxygen saturation). From a total of 380 episodes of correct oxygen delivery, the delivery system was the same that the one transcribed in 93.9%. The delivered output or FiO_2 corresponded to the transcribed in 91.3%.

In 89 episodes it was used a humidifier being it use appropriate in 90.8%; 74.8% were before the expiry date and 65.2% had adequate levels of water.

Considering all aspects of oxygen delivery only 58.5% of episodes weren't in total agreement with the transcription. If we still considered the correct use of humidifier the oxygen delivery was correct in only 51.1% of episodes (*Fig. 2*).

Oxygen therapy during the intra-hospital transport of patients was positive in 87 episodes. In all episodes it was administered oxygen during transport and in 97.7% was used the same delivery system or it occur a correct change in the system, respecting the output or FiO_2 delivered in the ward. The same output or FiO_2 were delivered in 92% of episodes.

Oxygen delivery during the patient's hygiene was observed in 374 episodes. In 87.7% oxygen was delivered. From these, the ward delivery system (or an adequate change) was present in 98.2%. The same output or FiO_2 were delivered in 91.7%.

Oxygen administration during meals was audited in 360 episodes. Oxygen therapy was kept during meals in 97.8% of episodes. The same delivery system (or appropriate change) was used in 99.1%. The output or FiO_2 was the same in 94.9%.

MONITORING

There was at least one arterial gas evaluation before the beginning of oxygen therapy or in the first 12 hours in 89.2% of prescriptions.

From a total of 444 episodes of delivery or potential delivery (using an interval objective of saturation oxygen) of oxygen therapy, it was found at least a daily record of $SatO_2$ in 86%. Considering episodes with oxygen therapy prescription, transcription, delivery and monitoring, monitoring was performed as transcribed in 86.7% of episodes (*Fig. 2*).

Monitoring oxygen therapy in patients with acute hypercapnic respiratory insufficiency through continuous oximetry and arterial gasometry was carried out in only 2.4% and 41.3% of episodes, respectively.

In episodes of prescribing oxygen therapy aiming a $SatO_2$ interval, $SatO_2$ was out of the defined interval in 41.1%. From these, it was made a change of output or FiO_2 in 20.7% having 75% reached the aimed target of $SatO_2$.

DISCUSSION

This clinical audit has identified a higher rate of oxygen prescriptions, transcriptions and deliveries than other studies previously published. [2,4] However the quality of such procedures was not ideal mainly

what refers to monitoring.

Only seven episodes have no prescription of oxygen therapy. In spite of this fact being satisfactory, when we consider all aspects of a correct oxygen prescription, it was not reached the same success. As a matter of fact only 51.2% of "fixed dose" prescriptions episodes have included all the necessary parameters. Where the delivery system, whether the output or FiO_2 had good compliance rates, well above 90%. The problem emerges with the prescription of the duration and monitoring of oxygen therapy. The absence of the prescription duration usually leads to the continuous delivery of oxygen which can lead to hyperoxia. This is a very serious situation, mainly in hypercapnic respiratory insufficiency where the prescription for objective interval of $SatO_2$ is particularly advantageous. Besides, in the absence of a $SatO_2$ monitoring prescription there is a risk whether of hypoxia or hyperoxia, without any control on the oxygen delivery. Both situations are harmful for the patient leading to a higher morbidity and mortality.

Less than a third of audited episodes had an oxygen prescription aiming a $SatO_2$ interval, when present, often the range defined was not appropriate to the kind of respiratory insufficiency. Such type of prescription, in spite of being less complex and more flexible to the patient needs,[1] was recently introduced to the medical community. Probably it was for this reason that represents only a small part of oxygen prescriptions and were found so many mistakes in the definition of the $SatO_2$ aimed interval. However, the three interval of $SatO_2$ considered were still in discussion by the medical community when our auditing was performed[9] and later were changed regarding type 1 respiratory insufficiency. [1] On the other hand it is important to highlight that this kind of prescription requires a higher availability of the nursing team, being much more time consuming.

Considering the nursing transcription in approximately a quarter of the episodes the criteria of good practice was not reached. The nursing IT application demands that each oxygen therapy parameter is introduced separately. The best way of ensuring a medical prescription precise copy is its direct translation, electronically, eliminating the human error on the transcription process.

What regards the oxygen delivery, whether the delivery systems, or the output or FiO_2 agreed with the transcription in over 90% of episodes. A significant percentage of episodes of administration for the $SatO_2$ aimed interval were outside such interval limits. Just a fifth of such situations were followed by an output or FiO_2 adjustment, and 75% reached the aimed interval. The nursing team inexperience titling oxygen and the ratio nurse/patient can be responsible for the low rates of compliance. It should be highlighted that in three quarters of episodes where it was verified a nursing team intervention adjusting the oxygen delivery, the aimed $SatO_2$ was reached.

In spite of having been verified a good selection of situations for the use of humidifiers, the respect for the expiry date or water levels was not near the expected. The inadequate use of humidifiers can increase the risk of nosocomial infections of the respiratory tract.[8] Its use should be restricted [1] and should be in place a daily routine evaluation to avoid such situations.

In general, the evaluation of all these delivery parameters results that only half of the episodes were according to the nursing transcription. This is alarming. Several factors can contribute for these results but surely it is necessary to offer a better training to all health professionals regarding the best practice for oxygen therapy.

Oxygen therapy during patients' transport and meals were according to those practiced in the ward. The same was not verified during the hygiene. It is necessary to reinforce the importance of keeping oxygen therapy in hypoxemic patients, regardless of the place or moment where they are.[8]

Monitoring oxygen therapy by nurses and physicians is far from being appropriate, particularly in the acute hypercapnic respiratory insufficiency, where continuous oximetry is recommended with daily arterial gasometry. The characteristics of such patients demand a higher effort from the health team and only with the correct monitoring can be delivered the best care. The limited number of oximeters and the ratio nurse/patient can be a significant motive for inadequate monitoring of such patients.

To improve health professionals training regarding oxygen therapy is a priority, in spite of previous work suggesting low success in this kind of initiative.[4,11,15] A combined strategy of training, protocol implementation, universal use of prescription for the $SatO_2$ aimed interval[1,16] and IT applications with safety alarms to regulate prescription and transcription can improve oxygen therapy delivery.

CONCLUSIONS

In spite of being common in acute patients treated in hospitals, oxygen therapy is not practiced according to the state-of-the-art.

The auditors have identified practices to be improved in all the four stages of oxygen therapy: prescription, transcription, delivering and monitoring.

Clinical audit to oxygen therapy is a powerful tool to provide the best health care for patients.

At present a training programme for physicians and nurses, as well as the implementation of protocols for oxygen therapy procedures and adjustments in IT applications of medical prescription and transcription and nursing records, is being carried out. During the first quarter of 2010 the clinical re-auditing will happen and can be evaluated the success of such initiatives. ■

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