ORIGINAL ARTICLE

AN AUDIT OF OXYGEN PRESCRIBING PRACTICES IN RESPIRATORY WARDS OF A TERTIARY CARE HOSPITAL IN NOTTINGHAMSHIRE, UK

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Background: This audit primarily assesses compliance with the British Thoracic Society guidelines (BTS) for oxygen prescriptions in the Respiratory Department at King's Mill Hospital. The results of this audit aim to guide the strategies to improve the oxygen prescription practices in the Trust. **Methods:** We collected the data on oxygen prescriptions, from the electronic prescribing system, of all the patients admitted in the three respiratory wards of King's Mill Hospital over the period of one week. This data was then recorded and analysed using Audit management and Tracking© (AMAT). **Results:** The overall compliance score to BTS guidelines for oxygen prescription was 12.2%. Out of the 152 patients, only 8 (5%) had oxygen therapy prescribed and a target oxygen saturation range was identified. No patient had an identifiable oxygen delivery method on their prescription. **Conclusion:** The current practices of oxygen prescription at the respiratory department of King's Mill Hospital are suboptimal. These findings highlight the risk of serious potential consequences and the opportunity to implement safe prescribing measures for oxygen, like other prescribed medications.

Keywords: Oxygen inhalation therapies; Respiratory failure; Electronic prescribing

Citation: Ahmed H, Nataraju K, Elmahdy AA. An audit of oxygen prescribing practices in respiratory wards of a tertiary care hospital in Nottinghamshire, UK. J Ayub Med Coll Abbottabad 2024;36(4):698–701.

DOI: 10.55519/JAMC-04-12375

INTRODUCTION

Oxygen is essentially a medicine, used to correct hypoxia. Like other medications, it has a therapeutic range and over/under oxygenation can lead to serious adverse effects.[1] It is well known that low oxygen levels cause tissue hypoxia interfering with all essential physiological processes while higher than necessary oxygen levels, especially in patients with COPD lead to respiratory depression, and causes oxidative stress among other things, all of which increase mortality.[1,2] Systematic review and meta-analysis of randomized controlled trials have shown that liberal oxygen therapy increases mortality in a dose-dependent fashion.[3] For that reason, it must be used with caution and prescribed appropriately. Correct and complete prescriptions ensure that an effective dose/quantity of oxygen is delivered to the patient to obtain the desired physiological effects.

For most of the patients, the recommended target oxygen saturation is 94–98%, except in COPD and other conditions with chronic hypercapnia, where the target is 88–92% to avoid respiratory depression and increased patient mortality.[2] British Thoracic Society (BTS) advises that all admitted patients should have an oxygen prescription, with a clearly outlined saturation goal, and signed, except in emergencies in which oxygen should be given without delay.[4] This ensures that appropriate oxygen levels can be administered if acute hypoxemia develops at any point during the inpatient stay. Despite these guidelines, it is widely recognized that oxygen prescriptions in hospitals are often inadequate.[5] With this audit, we aim to assess compliance with the BTS guidelines for oxygen prescription, in the respiratory wards at King's Mill Hospital (KMH).

MATERIAL AND METHODS

This was an observational, single-centre study. A proposal for conducting this study was discussed with the audit and improvement committee and respiratory audit lead at KMH, where it was approved. Since the study involved collecting anonymized data from electronic prescriptions, a formal institutional review board or ethics committee appraisal was not suggested.

King's Mill Hospital has a total of three respiratory wards. Data was collected over a period of one week from 29/03/2023 to 04/04/2023 for all the patients admitted to these respiratory wards. Consecutive sampling was applied to collect data. The inclusion criteria for the study encompassed all adult patients over the age of 16 admitted to any of the three respiratory wards at KMH during the specified week. This included all inpatients, regardless of whether they required oxygen upon admission, as well as patients receiving non-invasive ventilation. However, the study excluded patients admitted to departments other than the adult respiratory department to maintain focus on this specific population. Additionally, patients on invasive ventilation were not included in the study.

Audit standards were agreed beforehand. (Table-1) This audit mainly focused on whether the oxygen prescription with a target oxygen saturation has been completed or not. We did not investigate if that target was appropriate for the patient. A questionnaire was developed to standardize data collection based on BTS guidelines for oxygen prescription Table-2.

Table-1: Audit standards

Audit standards
A prescription for oxygen should always be provided.
Doctors and other prescribers should prescribe oxygen using a target saturation range and sign the electronic prescribing order.
An oxygen target saturation range should be prescribed for all patients who are admitted to the hospital.
A prescription should also have oxygen flow rate and delivery devices identified.

Table-2: Oxygen prescription questionnaire

Please circle Yes or No for each of the following:
Has oxygen therapy been prescribed?
2. Has the person prescribing signed the prescription?
Has target oxygen saturation been identified?
4. Has the oxygen flow rate and appropriate delivery systems been identified?
5. Has the respiratory model been updated on the nerve centre?

King's Mill Hospital uses Nerve Centre™ electronic prescribing system for all in-patient prescriptions. We examined electronic orders for a valid oxygen prescription for all patients in the respiratory department and checked if it meets all the essential criteria. On day one of data collection, data was collected from all the admitted patients and then newly admitted patients were added each day. In total, data was collected from 152 patients. Nursing and medical teams were not informed of the start date or duration of the audit.

All data was recorded and analyzed using Audit Management and Tracking (AMAT™)

RESULTS

Of the 152 patients in the study, only eight (5%) had oxygen prescribed Figure-1. Thankfully, these prescriptions were electronically signed, which is automatically done by the system based on the details of the logged-in user. The same eight patients had target oxygen saturation identified on the prescription.

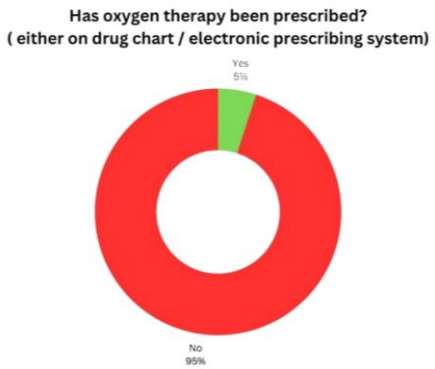

Figure-1: Percentage of patients with oxygen prescription

However, the oxygen flow rate and appropriate delivery system were not identified in any of the cases, which made all the prescriptions inadequate. In King's Mill Hospital's electronic prescribing system, i.e., Nerve Centre™, the section for recording observations has a preset "respiratory model". If this preset is turned on, the system will not trigger an alert to medical staff if oxygen saturation falls between 88–94%. This is quite useful for COPD patients where a lower saturation target is preferred and prevents unnecessary alerts. The respiratory model was turned on for 69 of the 152 patients (45%). This was a secondary observation and isn't necessarily a requirement of BTS guidelines.

The overall compliance score to National British Thoracic Society guidelines (BTS) for oxygen prescription was 12.2% as calculated by AMAT™, a stark divergence from the expected standards. The prescription rate is also much lower than other comparable healthcare systems in the UK.[6]

A summary of the results is as followed Table-3:

Table-3: Results

Question	Choice	Responses	%
Has oxygen therapy been prescribed?	Yes	8/152	5.3%
	No	144/152	94.7%
Has the person prescribing signed the prescription?	Yes	8/152	5.3%
	No	144/152	94.7%
Has target oxygen saturation been identified?	Yes	8/152	5.3%
	No	144/152	94.7%
Has the oxygen flow rate and appropriate delivery systems been identified?	Yes	0/152	0.0%
	No	152/152	100.0%
Has the respiratory model been updated on the nervecentre?	Yes	69/152	45.4%
	No	83/152	54.6%

The results compiled from the data showed that we have failed to meet the standards and criteria being set by the British Thoracic Society by a wide margin leading to a significant portion of patients being potentially exposed to adverse outcomes.

DISCUSSION

British thoracic society is the leading organization working to improve standards of care for people who have respiratory diseases and to support and develop those who provide that care. It routinely publishes evidence-based guidelines including that for supplemental oxygen. Respiratory is a well-established department at King's Mill Hospital, the hospital has embraced a consensus to adhere to the BTS guidelines concerning the delivery of supplemental oxygen, underlining the hospital's dedication to providing the highest level of care to its patients. However, this audit has now shown that compliance remains very poor.

The idea of an oxygen prescription has been introduced in guidelines to highlight the significance of oxygen as a formally prescribed medication.[7] This also aims to highlight like other medications, it has a therapeutic index and potential for adverse effects. The lack of oxygen prescription is a multifaceted issue. At the crux of this issue lies the complexity of oxygen prescription, which junior doctors typically carry out, and in our experience, many of whom are unfortunately unaware of the hospital's policy mandating comprehensive oxygen prescriptions for all patients. This lack of awareness signifies an information gap that, when bridged, can lead to significant improvements in compliance. During our study, we found that none of the patients had a specified flow rate or oxygen delivery devices indicated in their prescriptions. This appears to be an oversight in the electronic prescribing system at KMH, where the option to define a flow rate and oxygen delivery method is missing. Currently, this information is shared verbally between doctors and nurses, increasing the possibility of errors since the number of delivery devices, and the lack of accompanying information with many, make it difficult to choose the correct one.[8] Since the accurate selection of the proper flow rate and device significantly influences patient outcomes, it is crucial that this issue is promptly rectified.[9] This study is a critical call to action, highlighting the urgent need for improved adherence to evidence-based guidelines. To improve oxygen prescribing we are recommending a multidisciplinary approach to educate medical and nursing staff for which different avenues like teaching sessions, posters etc can be explored to re-enforce the oxygen prescription guidelines and to highlight the importance of oxygen toxicity.[10] Ward consultants' enthusiasm to uphold these guidelines is essential. The way the messenger is perceived can impact how well the message or clinical guidelines being conveyed are accepted and adopted by juniors.[11]

Recognizing the pivotal role of technology in contemporary healthcare, we recommend collaboration with the hospital's electronic prescribing leadership. This collaboration aims to integrate reminders into the electronic prescription system, which is known to boost prescription rates and reduce errors through automated prompts.[12] There are also certain areas of limitation within this study. Although the study gives a good snapshot of the rate of oxygen prescriptions, it doesn't investigate if the prescriptions were medically accurate. We didn't assess if the target saturations on the prescription were appropriate given the patients' comorbid like COPD, etc. like we have seen with similar audits.[13] The study also doesn't correlate arterial blood gases with oxygen therapy, which is considered the gold standard to see if a patient has the correct target saturations prescribed.[14] This data was collected only from respiratory wards which is not necessarily reflective of the practices at the entire hospital, although it was assumed that the oxygen prescription rates would be better compared to other wards. Our study was conducted in a district general hospital, which is a smaller setup compared to some tertiary care centres, so should be generalized nationally with caution. A multi-centre study including more hospitals is needed to improve generalizability of current findings. The data collection spanned for one week only and may not capture the practices throughout the year. Potential bias arising from the doctors involved in the study working on those wards during that time period leading to an increase in prescription cannot be ruled out. Our sample size was small and there was no categorization of patients into comorbid subgroups, which helps identify patients more at risk of adverse outcomes. An audit with a much wider scope would be needed before we make any vast generalizations. Additional audits are also warranted to examine any adverse effects stemming from the current poor prescription rate. Following the implementation of our recommendations, a follow-up audit will be conducted to evaluate the effectiveness of our interventions. The recommendations include educational sessions and posters aimed at enhancing prescription standards among medical and nursing staff. Progress will be assessed through regular Plan-Do-Study-Act (PDSA) cycles at King's Mill Hospital, with the expectation that continuous reminders and active measures will lead to sustained improvements in prescription practices. Our study findings will be presented at the hospital's monthly respiratory meeting, attended by all departmental stakeholders. This forum will facilitate the dissemination of best practices for oxygen prescription across all respiratory wards, ensuring that key insights and recommendations are shared widely within the department. We are collaborating with the electronic prescribing team to make oxygen prescription mandatory within the system. This update would prevent users from prescribing other medications unless a valid oxygen prescription is in place. The benefits and potential drawbacks of this approach are currently under discussion.

CONCLUSION

In summary, oxygen serves as a vital therapeutic tool to address hypoxia, functioning similarly to and should be treated like any other drug and prescribed appropriately. The study's findings shed light on the concerning disparity between oxygen prescription practices at King's Mill Hospital and the established British Thoracic Society (BTS) guidelines. Only eight (5%) out of the 152 patients included in the study had an oxygen prescription. This may potentially lead to poorer patient outcomes.

Comprehensive training and strict adherence to these guidelines are pivotal in guaranteeing patient safety within the hospital. This can be achieved through educational sessions aimed at reinforcing the existing guidelines for oxygen prescription and emphasizing the significance of being cautious about oxygen toxicity. Once these suggestions have been put into effect, a subsequent audit will be needed to evaluate whether there has been an enhancement in the quality of prescriptions. A multidisciplinary willingness to improve service provision is essential if we are ever to achieve 100% compliance. It's crucial to bear in mind that oxygen is a critical life-saving intervention, and the potential damage caused by tissue hypoxia far surpasses the risks associated with type 2 respiratory failure. For that reason, refraining from administering oxygen to a hypoxic patient solely due to the absence of a prescription is not advisable.

Conflicts of interest:

All authors have confirmed that there is no conflict of interest.

Research and Publication Ethics:

A proposal for conducting this study was discussed with the audit and improvement committee and respiratory audit lead at King's Mill Hospital, where it was approved. Since the study involved collecting anonymized data from electronic prescriptions, a formal institutional review board or ethics committee appraisal was not suggested. There is no formal approval number given for this study.

Acknowledgements

The authors would like to thank Dr Khaled Amsha (Respiratory Medicine, King's Mill Hospital, Nottinghamshire, GBR) for his supervision during this audit. We would also like to thank Dr Shaheen Shahid (Respiratory Medicine, King's Mill Hospital, Nottinghamshire, GBR) for his valuable insight and guidance.

AUTHORS' CONTRIBUTION

HA: Contributed to this write up, proof reading, data collection and coordinating with other authors. KN: Contributed to literature search and formulating results. AAE and MAC: Contributed to the data collection and discussion section of this publication

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Submitted: August 18, 2023	*Revised: November 2, 2024*	*Accepted: November 4, 2024*

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