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Assessing The Utilization and Management of Medical Oxygen in Ethiopian Hospitals

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Abstract: *Ensuring reliable access to medical oxygen is critical to a quality healthcare system. A descriptive observational study was conducted over 6 months to examine the management and utilization of oxygen in hospitals across Ethiopia, focusing on facility and patient data. The study included 11 hospitals in 6 regions of Ethiopia, with data collection from emergency departments, ICUs, NICUs, pediatric and medical wards. Results showed that 36.36% of facilities had a functioning oxygen system, but less than half had a straightforward person in charge of oxygen and a standardized therapy flow. Meanwhile, 54.55% of facilities reported having medical personnel trained in oxygen therapy, although the number of trained staff varied. Incomplete oxygen prescriptions were shared, such as missing flow rates, SpO2, and monitoring frequency. However, patients who received oxygen therapy had a significantly higher recovery rate (66.23%) compared to patients who did not receive oxygen (21.43%). These findings indicate significant gaps in the availability and management of oxygen infrastructure and suboptimal oxygen administration and monitoring practices. A multifaceted approach is needed to remedy this, including improved functioning of oxygen plants, the appointment of dedicated oxygen attendants, standardized therapy protocols, broader training of medical personnel, and standardization of oxygen funding and costs.*

Keywords: Ethiopian Hospitals, oxygen inhalation therapy, observational study

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INTRODUCTION

Residents of the 28 Low-Income Countries (LICs), 23 of which are situated in sub-Saharan Africa, such as Ethiopia, experience a markedly higher prevalence of critical diseases, surpassing that of high-income countries (HICs) by more than four times (Razzak et al., 2019). This disparity highlights the urgent need for improved healthcare infrastructure, particularly in resource-limited settings. The importance of oxygen service delivery has been globally recognized, with the World Health Organization (WHO) and other international organizations emphasizing comprehensive strategies to prove access to this essential medical resource (WHO, 2024).

In Ethiopia, one significant challenge is nurses' management of oxygen use (Getahun et al., 2022). Oxygen therapy is vital for a wide range of conditions, from life-threatening emergencies such as trauma and acute respiratory distress syndrome (ARDS) to chronic diseases like chronic obstructive pulmonary disease (COPD) and severe (Mangipudi et al., 2020). Additionally, it plays a crucial role during emergencies, surgical procedures, and in treating patients with certain neurological and cardiovascular conditions (Graham et al., 2021). Ensuring a consistent supply of medical oxygen is, therefore, an essential component of a healthcare system that is both efficient and resilient (Bradley et

al., 2015; Tolla et al., 2021). Other complications that can occur if oxygen is not distributed properly, such as heart failure, increased heart rate, right ventricular dysfunction of the heart, brain damage, liver kidney up to coma (Kristinawati et al., 2024; Zhong et al., 2021).

In clinical environments, supplementary oxygen is frequently necessary for patient management and rehabilitation, underscoring its significance in modern medicine (Phelan et al., 2022). By enhancing oxygenation, healthcare practitioners can significantly improve patient outcomes and aid in successful illness treatment (Howie et al., 2020). However, a lack of sufficient expertise in managing and administering medical oxygen among healthcare professionals exacerbates the issue. Additionally, inadequate storage facilities, such as inadequate oxygen tanks under ideal conditions, can lead to waste (Ibrahim et al., 2025).

This study aims to assess the current practices surrounding the utilization and management of medical oxygen in Ethiopian hospitals, focusing on identifying critical gaps in urban and rural healthcare settings. By evaluating the efficiency of oxygen supply chains, storage practices, and distribution systems, the research seeks to provide a comprehensive understanding of the challenges faced by hospitals nationwide.

METHODS

Study design

A descriptive observational study was conducted to examine and document the management and use of oxygen in hospitals across Ethiopia, focusing on facility- and patient-level data. Facility-level data included the availability and functionality of oxygen installations, the presence of an oxygen focal point and therapy flow chart, training for healthcare workers in oxygen management, sources of oxygen, cost information, and related financial details. The sampling targeted 11 hospitals across 6 regions of Ethiopia: Addis Ababa, Afar, Amhara, Gambella, Oromia, and Somalia. The selected hospitals comprised a mix of tertiary, general, and primary hospitals. Data were collected from emergency departments, ICUs, NICUs, pediatric wards, and medical wards.

Data Collection

Medical records data for six months, from January 1, 2023, to June 30, 2023, were randomly selected, with approximately 10 medical records collected from each hospital. This data includes detailed information on clinical presentations, oxygen prescription and administration practices, SpO_2 monitoring, and clinical outcomes.

Ethical Considerations

The researcher obtained prior approval from hospital management for data collection and informed all staff about the research observations. Patient identities were kept confidential, and the data collection did not interfere with patient care or hospital operations. The study protocol was reviewed and approved by the institutional review board of the Ethiopian Public Health Institute.

Data Analyzed

This study used frequency distribution and percentages to analyze the data. Frequency distribution identifies how often each category or group appears, while percentages provide a proportional view of the total respondents or events. The findings are displayed using bar charts and pie charts to represent data distribution.

RESULTS

Based on the observations made by the researcher, the researcher categorized the description of Medical Oxygen Utilization and Management in 11 Hospital facilities in Ethiopia:

Facility-level Findings

Oxygen Plant Availability and Functionality

This study obtained assessment results from 11 facilities in Figure 1, 4 (36.36%) had a functional oxygen plant, 2 (18.18%) had a non-functional plant, and the remaining 5 (45.45%) had no oxygen plant at all.

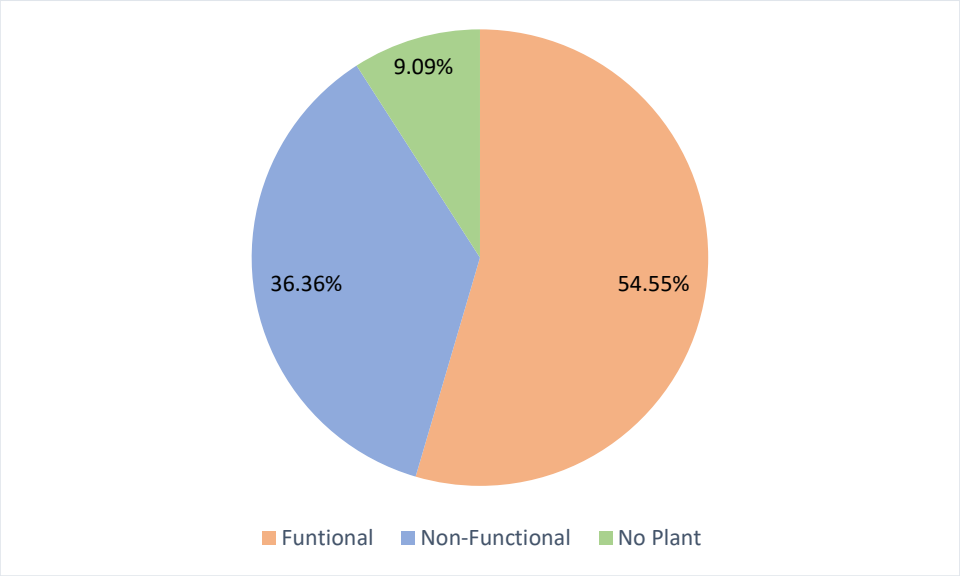

Figure 1: Oxygen Plant Availability and Functionality

Oxygen Focal Persons and Therapy Flow Charts

Only 5 out of the 11 facilities (45.45%) had an identified oxygen focal person who was a member of the Drug and Therapeutics Committee (DTC). Furthermore, four facilities (36.36%) had an Oxygen Therapy Flow Chart available.

Healthcare Worker Training in Oxygen Therapy

Of the 11 facilities, 6 (54.55%) reported having healthcare workers trained in oxygen therapy, with the number of trained staff ranging from as low as 10 in one facility to as high as 120 in another.

Oxygen Procurement and Funding

Some facilities (4 out of 11, or 36.36%) reported having a separate budget code or line item for oxygen, while the remaining 63.64% of facilities sourced oxygen funding from the pharmaceutical budget. The cost of oxygen per cubic meter, including transportation, ranged from 250 to 780 Ethiopian Birr, with an average of 520 Birr per cubic meter. Regarding user fees, five facilities (45.45%) charged patients for oxygen therapy.

Patient-level Findings

Presence of Respiratory Symptoms and SpO2 Monitoring

Most patients (88 out of 95, or 92.63%) presented with respiratory symptoms. Most patients (79 out of 95, or 83.16%) had at least one SpO2 reading recorded on the day of admission, but the frequency of monitoring varied.

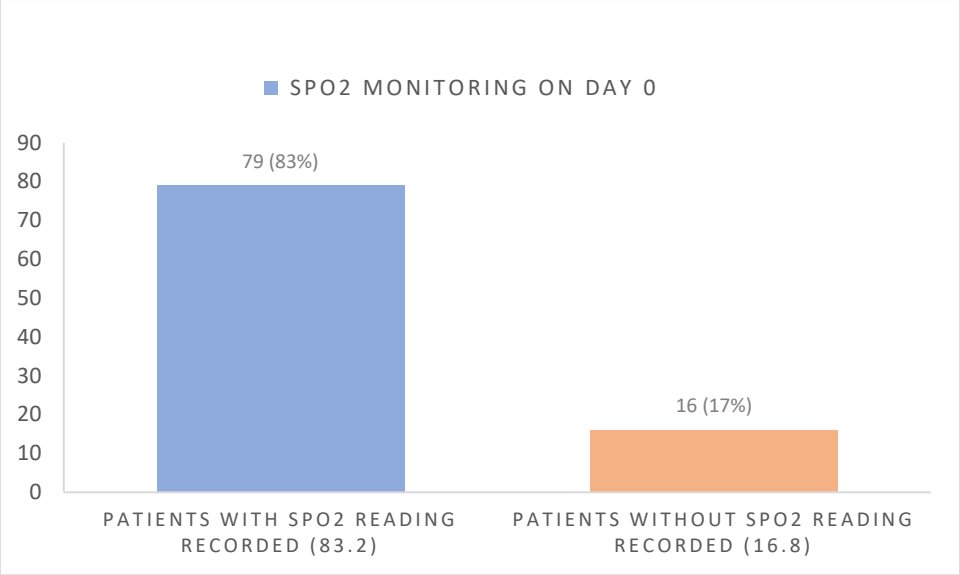

Figure 2: SpO2 Monitoring on Day 0 (Day 0 is the day the patient was admitted)

Oxygen Prescription and Administration

Out of the 95 patient records reviewed, 77 (81.05%) had oxygen prescribed. However, the prescriptions were often incomplete, lacking critical details such as the flow rate, target SpO2, and frequency of monitoring. Despite the incomplete prescriptions, most patients (66 out of 77, or 85.71%) received oxygen therapy during admission.

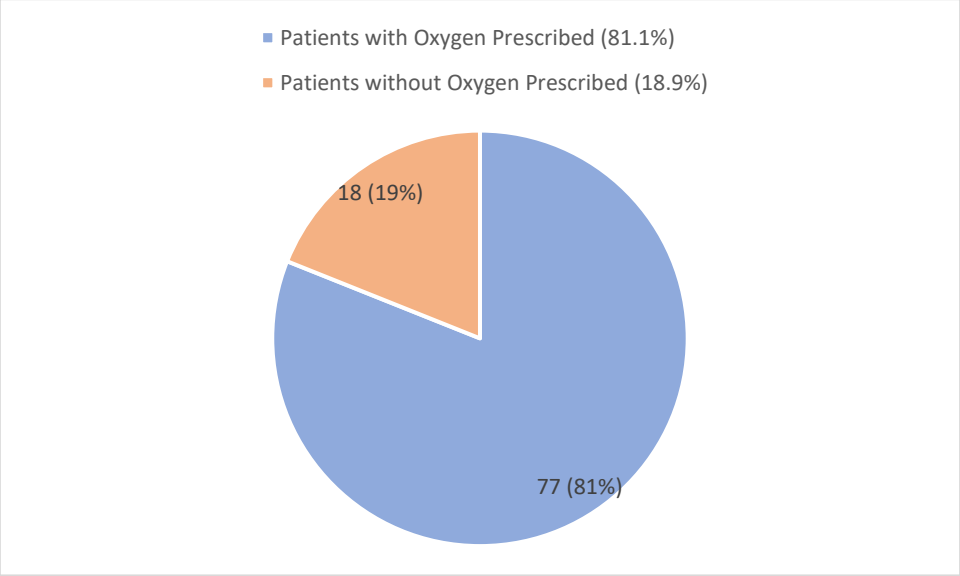

Figure 3: Oxygen Prescription and Administration

The data shows that prescription completeness, as measured by whether the flow rate was stated, target SPO2, and monitoring frequency specified, were quite low. Only 30.3% of the prescriptions included at least the flow rate information, while a significant majority, 69.7%, did not state the flow rate at all.

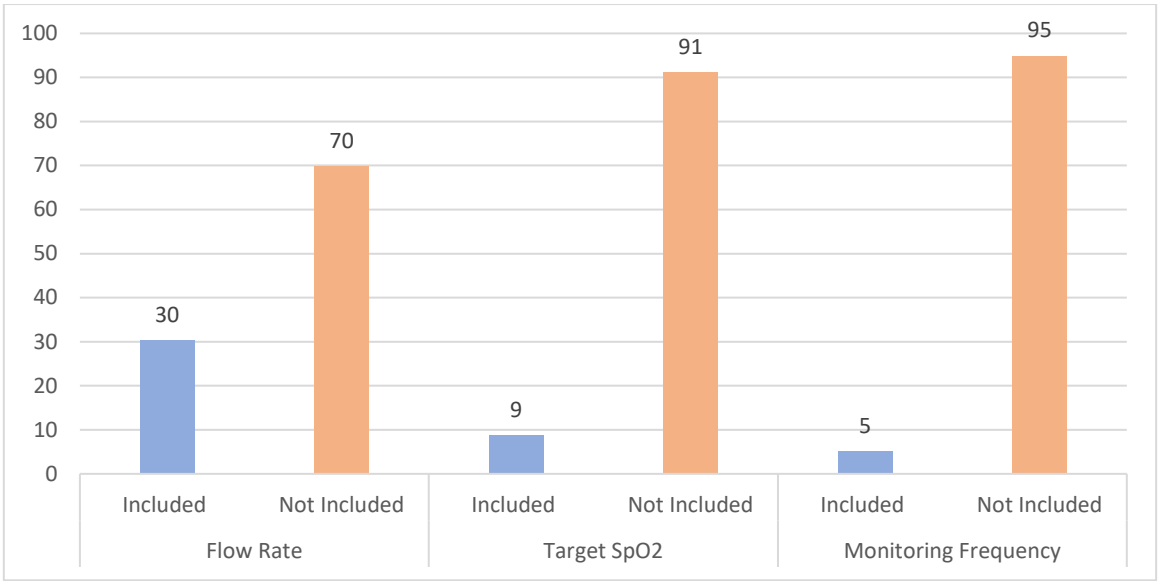

Figure 4: Prescription Completeness

Patient Outcomes

The discharge/recovery rate among patients who received oxygen therapy was 66.23% (51 out of 77 patients), compared to 21.43% (3 out of 14 patients) for those who did not receive oxygen.

DISCUSSION

The results of this study show that there are some significant challenges in the use and management of medical oxygen in Ethiopian hospitals. The findings in 11 hospital facilities found that many facilities still do not have a functioning oxygen plant, contributing to the difficulty in providing sufficient oxygen to patients in need, especially in emergency conditions, which shows the importance of efficient oxygen management to improve care outcomes in low-income countries (Razzak et al., 2019). Based on other data, it appears that the management of oxygen in Ethiopian hospitals might be considerably improved by enhancing the capacity of storage facilities and improving the supply chain systems for oxygen (Baker et al., 2024; Tolla et al., 2021). The improvement of efficient oxygen distribution systems must be followed by careful design to overcome geographical and logistical constraints, especially in places that are difficult to access. These oxygen distribution issues greatly affect the quality of medical care, especially in hospitals treating patients with critical conditions, such as trauma or acute respiratory distress syndrome (ARDS) (Wang et al., 2020).

Conversely, researchers discovered that the insufficient training provided to healthcare personnel, particularly nurses, has markedly intensified this issue. Although oxygen therapy is crucial in treating several medical problems, including respiratory disorders and post-operative care, numerous healthcare professionals remain insufficiently trained with the requisite knowledge and abilities for efficient management (Navuluri et al., 2021). This deficiency in training undermines the quality of patient treatment and raises issues regarding patient safety (Belle et al., 2010; Getahun et al., 2022). Consequently, there is an immediate necessity for extensive education and skills development programs that provide healthcare professionals with the expertise to administer oxygen treatment effectively and appropriately (Kodama et al., 2023).

Incomplete oxygen prescriptions, with important details such as flow rate, target SpO2, and monitoring frequency often needing to be added, suggest increased standardization and training in oxygen therapy practice. However, the higher discharge/recovery rate among patients receiving oxygen therapy underscores the critical role of this important medical resource in patient care. Another study found that oxygen availability was associated with reduced mortality in children with pneumonia in low- and middle-income countries (Pelletier et al., 2021). The study also found that

government efforts towards funding used for oxygen facilities were inadequate overall, In line with previous studies on the need for resuscitation provision is still lacking in most health facilities in Cross River State (Kalu et al., 2022). This situation significantly limits the capacity of the health system to save lives, especially during emergencies (Kaseje et al., 2021).

A lack of knowledge on how to effectively manage oxygen can lead to suboptimal oxygen administration and affect patient outcomes, especially in patients with chronic diseases or in critical condition (Mangipudi et al., 2020). It is important to formulate policies that prioritize equitable and fair distribution of oxygen, and improvement of health facility services with a special focus on low-income areas. In addition, to improve the quality of care, national policies need to include training for medical personnel on how to properly manage oxygen resources (Nyarko et al., 2016). Based on the experience of other countries that have effectively improved oxygen management, it appears that initiatives concentrating on healthcare staff education and infrastructure improvements can result in considerable improvements in patient health outcomes (Nabwire et al., 2018).

The study had a relatively larger sample size compared to previous assessments, with data collected from 11 facilities across selected regions in Ethiopia. However, the retrospective nature of the patient-level data may have limited the ability to capture certain contextual factors that could have influenced the clinical outcomes. Additionally, the study did not include qualitative data, such as in-depth interviews with healthcare providers and policymakers, which could have provided further insights into the underlying drivers of the observed challenges.

CONCLUSION

This thorough study of oxygen service delivery and treatment methods in selected Ethiopian hospitals shows severe gaps in oxygen infrastructure availability and management and inadequate oxygen prescription and monitoring practices. The research also shows that oxygen treatment improves patient outcomes, emphasizing its importance. Nurses and other healthcare personnel need enough training to improve performance and care. The identified challenges require improvements in oxygen plant functionality, the appointment and training of dedicated oxygen focal persons, the development of standardized therapy protocols, the expansion of healthcare worker training, and the standardization of oxygen funding and user fee structures. These evidence-based solutions will improve patient outcomes and provide equal access to medical oxygen in Ethiopia by enhancing oxygen availability and use.

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AUTHOR CONTRIBUTIONS

Alemayehu Berhanu Belete (ABB), Beti Kristinawati (BK)

ABB developed the study design performed the data analysis, prepared the manuscript, and reviewed and edited the final manuscript. BK reviewed and edited the manuscript. Both authors participated in the revision process and approved the final version of the manuscript.

FUNDING STATEMENT

No funding has been received to conduct this study.

DATA AVAILABILITY STATEMENT

The data will be shared by the corresponding author upon approval of the Ministry of Health of Ethiopia.

CONFLICT OF INTEREST STATEMENT

The authors of this work have not disclosed any conflicts of interest.

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