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Feasibility Study of Portable Pulse Oxygen Therapy Devices in Inpatient Settings: A Clinical Pilot Analysis Based on 109 Cases

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Abstract: *This study aimed to evaluate the feasibility and clinical performance of portable pulse oxygen concentrators in hospital settings. A total of 109 inpatients from four departments—General Medicine, Respiratory Medicine, Geriatrics, and Critical Care Rehabilitation—were enrolled. Each patient underwent oxygen therapy using both a portable pulse-dose oxygen device and a conventional wall-mounted continuous-flow system. Key physiological indicators, including oxygen saturation (SpO_2), heart rate (HR), and respiratory rate (RR), were recorded and compared. Statistical analysis showed no significant difference in SpO_2 between the two methods (P=0.24), while HR showed borderline improvement (P=0.051), and RR showed significant improvement with the portable device (P=0.008). Most patients were able to maintain stable parameters at low to medium flow settings, indicating good efficiency and adaptability. The portability of the device also enhanced patient mobility and comfort, especially in rehabilitation and geriatric care scenarios. The findings suggest that portable oxygen concentrators provide comparable clinical effectiveness to wall-mounted systems and offer added benefits in terms of flexibility and usability. These results support the device's potential role as a supplementary option in inpatient oxygen therapy.*

Keywords: *Portable oxygen concentrator; pulse-dose oxygen therapy; inpatient oxygen therapy; clinical pilot study; oxygen saturation; respiratory rate*

1. Introduction

Oxygen therapy is a fundamental and vital supportive treatment widely used in the management of chronic obstructive pulmonary disease (COPD), interstitial lung disease, postoperative recovery, and long-term care for elderly patients. In most hospitals, continuous-flow oxygen delivery systems connected to central pipelines are used as the standard method. While these systems provide a stable and uninterrupted oxygen supply, they are heavily reliant on hospital infrastructure and pose limitations in terms of flexibility, mobility, and maintenance cost.

In recent years, portable oxygen concentrators, especially those using pulse-dose oxygen (PO) delivery technology, have gained popularity in home care and patient transport. These devices are designed to detect the user's inhalation effort and deliver oxygen in response to inspiration, thereby improving oxygen utilization and reducing carbon dioxide retention. This approach enhances both comfort and safety for patients. Their compact, lightweight, and plug-and-play design also offers greater convenience for healthcare providers in clinical settings.

Despite growing adoption in outpatient and home-based scenarios, there is a lack of systematic research evaluating the clinical effectiveness and safety of portable oxygen devices in inpatient environments. Particularly, there is limited real-world data across departments and age groups. This study presents findings from a clinical pilot trial conducted at Nanjing Jiangning Hospital involving 109 patients. It aims to compare portable pulse oxygen concentrators with standard wall-mounted continuous-flow systems in terms of key physiological indicators and usability, and to explore their clinical applicability in inpatient rehabilitation, transfer, and pre-discharge scenarios. The findings are intended to provide evidence for potential integration into routine inpatient oxygen therapy systems[1].

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2. Methods

2.1. Study Design and Timeline

This was a prospective, comparative clinical pilot study conducted at Nanjing Jiangning Hospital over a 62-day period, from November 22, 2024 to January 23, 2025. The objective was to assess the feasibility, clinical performance, and user experience of portable pulse oxygen concentrators across different inpatient departments, in comparison with standard continuous-flow wall-mounted oxygen systems.

2.2. Participants

A total of 109 hospitalized patients who required low-flow oxygen therapy were enrolled. The patients, aged between 23 and 93 years, were from the following four departments:

- General Medicine
- Critical Care Rehabilitation
- Respiratory Medicine
- Geriatrics

Patients requiring high-flow or high-pressure oxygen therapy, or those experiencing acute cardiopulmonary failure, were excluded.

2.3. Devices and Interventions

The portable pulse oxygen concentrator used in this study was the INOGI-R1 model, which holds Class II medical device certification in China and complies with international standards such as IEC 60601, ISO 80601, and ISO 18562. It features pulse-dose delivery, real-time flow control, long battery life, and alarm functions. The device delivers ≥90% oxygen concentration, with a maximum pulse flow of 1.47 L/min, volume ≤2.65 dm^3, and weight ≤1.8 kg.

The wall-mounted system used was the hospital's standard central oxygen pipeline. The oxygen flow settings were kept consistent between both systems for each patient. All patients underwent alternate oxygen delivery using both systems under matched conditions.

2.4. Data Collection and Indicators

Primary indicators included the following physiological parameters:

- Oxygen saturation(SpO_2, %)
- Heart rate(Heart Rate, bpm)
- Respiratory rate(Respiratory Rate, breaths/min)

Secondary data collected included:

- Distribution of flow level usage
- Patient comfort and mobility feedback
- Device adaptability across age groups

2.5. Statistical Analysis

All data were analyzed using SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (mean ± SD). Paired t-tests were used to compare the three key physiological indicators (SpO_2, HR, RR) between the portable and wall-mounted systems under matched conditions. A two-sided P value < 0.05 was considered statistically significant.

The results of the paired t-tests were as follows:

- SpO_2: $t = 1.17$, $P = 0.24$, 95% CI: (−0.13, 0.50)

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- HR: t = −1.98, P = 0.051, 95% CI: (−3.84, 0.00)
- RR: t = −2.71, P = 0.008, 95% CI: (−1.62, −0.25)

Among the three indicators, only RR showed statistically significant improvement with portable oxygen use ($P < 0.01$), suggesting potential benefits in respiratory synchronization and patient comfort. Subgroup analyses by department were also conducted to assess differences in response across clinical settings.

3. Results

3.1. Comparison of Oxygen Saturation (SpO_2)

A total of 109 patients were included in the analysis.

Table 1. Comparison of Oxygen Saturation (SpO_2) Across Departments

Department	SpO_2 with Portable Device (%)	SpO_2 with Wall-Mounted System (%)	Mean Difference (%)	Mean Age
General Medicine	98.64%	98.48%	0.16%	67.2
Critical Care Rehab	98.41%	98.36%	0.05%	72.4
Respiratory Medicine	97.87%	97.21%	0.66%	70.0
Geriatrics	96.08%	96.92%	-0.84%	83.3

As shown in Table 1, the comparison of oxygen saturation under different oxygen delivery systems across clinical departments shows only minimal variation.

Paired t-test analysis showed no statistically significant difference in SpO_2 between the two systems (t = 1.17, P = 0.24, 95% CI: −0.13 to 0.50).

Overall, the portable device demonstrated slightly better performance in the respiratory department and slightly lower values in the geriatric group, suggesting comparable effectiveness to the wall-mounted system.

3.2. Comparison of Heart Rate (HR)

Table 2. Comparison of Heart Rate (HR) Across Departments

Department	HR with Portable Device (bpm)	HR with Wall-Mounted System (bpm)	HR Difference (bpm)	Mean Age (years)
General Medicine	80.39	82.46	-2.07	67.2
Critical Care Rehab	81.09	84.27	-3.18	72.4
Respiratory Medicine	77.94	80.64	-2.70	70.0
Geriatrics	78.56	82.44	-3.88	83.3

As seen in Table 2, in all departments, the heart rate decreased more when using the portable device. The largest reductions were observed in the critical care rehabilitation and geriatrics departments. The paired t-test for the overall sample showed a borderline significant improvement (t = −1.98, P = 0.051, 95% CI: −3.84 to 0.00), indicating potential clinical benefit.

3.3. Comparison of Respiratory Rate(RR)

As summarized in Table 3, the portable device showed greater reductions in respiratory rate across all departments. The improvement was most notable in the critical care rehabilitation group. Paired t-test results indicated a statistically significant reduction (t = −2.71, P = 0.008, 95% CI: −1.62 to −0.25), suggesting a potential physiological advantage in respiratory synchronization.

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Table 3. Comparison of Respiratory Rate (RR) Across Departments

Department	RR with Portable Device (bpm)	RR with Wall-Mounted System (bpm)	RR Difference (bpm)	Mean Age (years)
General Medicine	18.11	18.31	-0.20	67.2
Critical Care Rehab	17.18	18.45	-1.27	72.4
Respiratory Medicine	18.05	18.51	-0.46	70.0
Geriatrics	16	16.5	-0.50	83.3

3.4. Age and Flow Level Distribution

As shown in Figure 1, the majority of patients enrolled in this study were between the ages of 60 and 89 years, with the largest subgroup being those aged 70–79. This distribution highlights the strong applicability of the portable oxygen device for older adult populations, particularly those in geriatric and chronic disease departments.

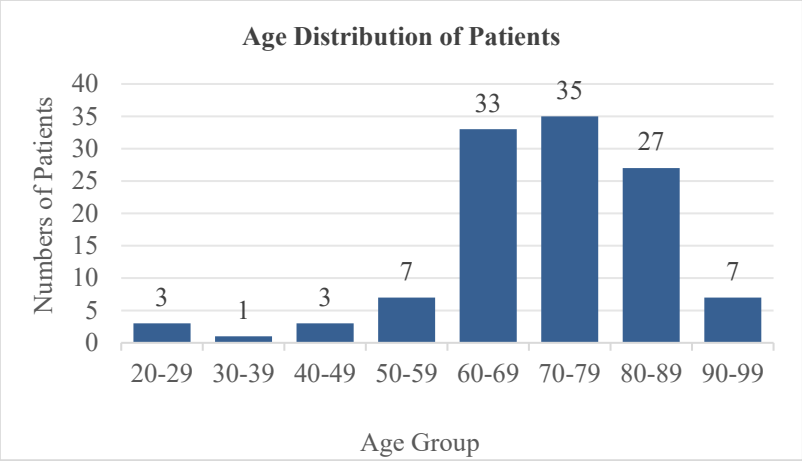

Figure 1. Age Distribution of Enrolled Patients

As depicted in Figure 2, Level 6 was the most frequently used flow setting, accounting for 32% of usage. However, flow Levels 2 through 4 together made up more than half of all usage (52%), suggesting that most patients achieved adequate oxygenation at low to medium settings. This supports the device's efficiency in delivering oxygen while optimizing power consumption.

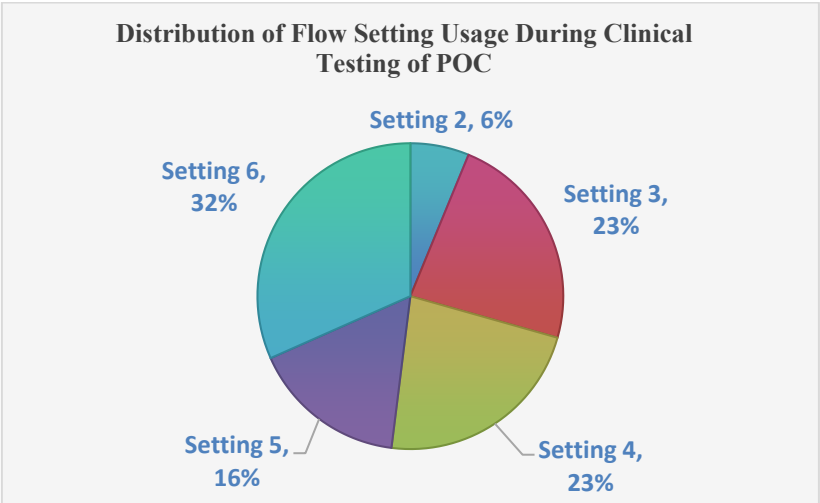

Figure 2. Flow Setting Usage Distribution During Clinical Testing

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4. Discussion

This clinical pilot study evaluated the feasibility and clinical performance of portable pulse oxygen concentrators in an inpatient setting across four departments. The results showed comparable effectiveness to conventional wall-mounted continuous-flow systems in maintaining key physiological parameters, with a statistically significant improvement in respiratory rate and a trend toward better heart rate control.

4.1. Comparable Effectiveness and Clinical Equivalence

The study found no significant difference in oxygen saturation between the two systems, suggesting that portable devices are capable of maintaining oxygenation at levels similar to wall-mounted systems in low-flow oxygen therapy. The trend of reduced heart rate and significantly lowered respiratory rate in the portable device group may indicate improved respiratory efficiency and synchronization. These findings provide preliminary support for the use of portable devices as a supplementary oxygen delivery method in inpatient care[2]。

4.2. Enhancing Mobility and Patient Engagement

Compared to wall-mounted systems, which are restricted by central pipeline infrastructure, portable devices offer greater flexibility in patient movement and bedside care. Their compact design and untethered operation make them especially useful during rehabilitation, post-operative mobilization, and in-bed transfer scenarios. Clinical feedback suggested improved patient comfort and compliance, particularly among elderly and respiratory-compromised patients[3]. These features may facilitate improve recovery and enhance patient autonomy during hospitalization.

4.3. Flow Setting Adaptability and Energy Efficiency

Flow level usage analysis showed that the majority of patients were able to maintain stable physiological parameters at Levels 2–4, accounting for over half of all usage instances. This indicates the device not only meets clinical oxygen needs but also performs well in conserving energy and extending battery life, which is consistent with findings from previous trials on ambulatory oxygen use in normoxaemic COPD patients [4].

4.4. Economic Potential and Implementation Scenarios

The device's independence from central oxygen infrastructure makes it particularly valuable in emergency departments, low-resource facilities, and during internal patient transport. Furthermore, it may serve as a transitional tool within a continuum of oxygen therapy that spans inpatient, community, and home care. While this study did not assess economic outcomes directly, the device's lightweight design, low maintenance requirements, and deployment flexibility suggest potential for wider implementation, pending further cost-effectiveness studies.Its independence from centralized systems makes it especially useful in low-resource facilities, as emphasized by WHO during the COVID-19 oxygen accessibility challenge[5].

5. Conclusion

This study demonstrated that portable pulse oxygen concentrators are clinically feasible and effective for use in inpatient settings. They provide comparable oxygenation outcomes to wall-mounted systems and show advantages in respiratory rate control, mobility, and adaptability, especially for elderly patients and those in rehabilitation phases.

The ability to deliver effective oxygen therapy at lower flow settings suggests high oxygen efficiency and suitability for a wide range of clinical scenarios. These findings support the integration of portable oxygen devices as a complementary option in hospital-based oxygen therapy protocols.

However, as a single-center pilot study with a limited sample size, the conclusions drawn should be interpreted with caution. Future multi-center studies with larger sample sizes, along with formal cost-benefit analyses and patient-reported outcome measures, are recommended to fully validate the clinical and economic value of portable oxygen therapy devices.

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