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Patient Experiences and Satisfaction with Non-Invasive Home Respiratory Therapy Devices in a tertiary hospital

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Abstract:- **Background:** The increasing prevalence of chronic respiratory conditions has led to a greater reliance on home respiratory devices such as Continuous Positive Airway Pressure machines and oxygen concentrators. These devices are essential in managing conditions like obstructive sleep apnea and chronic obstructive pulmonary disease. Understanding patient experiences with these devices is vital for improving adherence and overall satisfaction. Non-invasive ventilation is widely recognized as the gold standard for treating OSA. It functions by delivering a continuous flow of air through a mask, preventing airway collapse during sleep. While NIV can significantly enhance sleep quality and reduce daytime drowsiness, adherence remains a significant challenge. It has been reported that nearly 30% of patients discontinue NIV therapy within the first year, primarily due to discomfort, nasal congestion, and feelings of claustrophobia. Such discontinuation not only affects the individual's health but can also lead to long-term complications associated with untreated sleep apnea, including cardiovascular disorders and impaired cognitive function. While NIV machines and oxygen concentrators are vital in managing chronic respiratory conditions, patient experiences vary widely based on numerous factors, including device comfort and cultural perceptions. This research will address the factors for patient experience and satisfaction with the use of non-invasive home respiratory therapy devices.

Methodology: A quantitative, cross sectional study design using online survey technique distributed among participants as data collection methods in a tertiary hospital. We will utilize two validated questionnaires in one form: the standard method for analyzing System usability scale (SUS) and the S3-NIV questionnaire. Usability will be assessed using the SUS, developed by Brooke in 1986, which has demonstrated reliability and validity in numerous studies. The S3-NIV questionnaire will also be used to assess patient experience.

Results: Total of 197 participants, with a mean age of 62.0 years (SD = 10.5) and a balanced gender distribution (55% male, 45% female). Participants reported an average device usage duration of 2.5 years (SD = 1.2). The System Usability Scale revealed a high overall mean score of 78.5 (SD = 12.3), with approximately 75% of participants scoring above 70, indicating strong perceived usability and ease of operation. Patient satisfaction, as measured by the S3-NIV questionnaire, was notably high, with 85% of participants reporting being "satisfied" or "very satisfied." While 70% found device setup easy, and 80% found daily operation easy, maintenance presented a more varied challenge. The devices had a generally positive impact on daily life for 60% of participants, though 25% reported a neutral impact

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and 15% a negative one. A weak but statistically significant positive correlation ($r = 0.45, p < 0.05$) was found between perceived usability and overall patient satisfaction. Importantly, no statistically significant correlations were identified between demographic factors (age, gender, duration of use) and either usability or satisfaction scores, suggesting a robust user experience across diverse patient profiles.

Conclusion: This study investigated patient experiences and satisfaction with non-invasive home respiratory therapy devices. It found high levels of perceived usability and overall satisfaction, with participants generally finding the devices easy to set up and operate. A statistically significant positive correlation between usability and satisfaction highlighted the importance of user-centered design for positive patient outcomes and enhanced quality of life. Despite these positive perceptions, device maintenance was identified as an area needing improvement, suggesting a need for simplified designs and enhanced patient education from manufacturers and healthcare providers. The varied impact of devices on daily life also indicates the importance of a holistic approach to patient care, beyond just device functionality.

Keywords: *Patient Satisfaction, Patient Experience.*

1. Introduction

The increasing prevalence of chronic respiratory conditions has led to a greater reliance on home respiratory devices such as Continuous Positive Airway Pressure (CPAP) machines and oxygen concentrators (Gruenberg et al., 2023). These devices are essential in managing conditions like obstructive sleep apnea (OSA) and chronic obstructive pulmonary disease (COPD) (Gruenberg et al., 2023). Understanding patient experiences with these devices is vital for improving adherence and overall satisfaction. Non-invasive ventilation (NIV) is widely recognized as the gold standard for treating OSA (Gruenberg et al., 2023). It functions by delivering a continuous flow of air through a mask, preventing airway collapse during sleep (Rapaport, 2022). Franke et al., 2024 found out that while NIV can significantly enhance sleep quality and reduce daytime drowsiness, adherence remains a significant challenge. Pataka et al., 2023 reported that nearly 30% of patients discontinue NIV therapy within the first year, primarily due to discomfort, nasal congestion, and feelings of claustrophobia. Such discontinuation not only affects the individual's health but can also lead to long-term complications associated with untreated sleep apnea, including cardiovascular disorders and impaired cognitive function (Pataka et al., 2023). Further exploring the factors influencing adherence, a systematic review by Pataka et al. (2023) emphasized the importance of education and training on device usage. Patients who receive comprehensive education about the device's benefits and proper usage techniques are more likely to maintain using respiratory therapy devices at home. However, the existing literature often overlooks the subjective experiences of patients, particularly the emotional and psychological aspects of using NIV machines (Pataka et al., 2023). Many patients report feeling embarrassed or self-conscious about wearing the device, especially in social situations (Luyster & Buysse, 2022). This emotional component

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can significantly impact adherence, suggesting a need for a more holistic approach in patient education and support (Luyster & Buysse, 2022). Furthermore, Oxygen concentrators are crucial for managing conditions like COPD, where supplemental oxygen is necessary to alleviate hypoxemia (Dakkak et al., 2021). A study by Lee et al. (2017) highlighted that patient satisfaction with home oxygen therapy is heavily influenced by the comfort and portability of the devices (Dakkak et al., 2021). Many patients express frustration regarding the weight and size of traditional oxygen concentrators, which often restrict their mobility and daily activities (Dakkak et al., 2021). Dakkak et al. (2021) found that patients frequently report challenges in maintaining an active lifestyle due to the logistical issues posed by these devices. Recent advancements in portable oxygen concentrators have provided some solutions to these challenges. According to (Vemula, Urich, & Kothare, 2021), newer models are lighter, quieter, and more user-friendly, leading to higher patient satisfaction and improved adherence. However, despite these advancements, many patients still experience barriers related to their environments, such as limited access to power sources during travel, which can hinder their ability to use the devices effectively (Vemula, Urich, & Kothare, 2021). While NIV machines and oxygen concentrators serve different purposes, both devices present unique challenges that patients must navigate (Vemula, Urich, & Kothare, 2021). A qualitative study by Okonkwo et al. (2021) directly compared patient experiences with NIV machines and oxygen concentrators, revealing significant differences in the challenges faced by each group. NIV users frequently reported issues related to mask fit, discomfort, and the sound of the machine, which can disrupt sleep (Okonkwo et al., 2021). In contrast, oxygen concentrator users highlighted concerns regarding device weight and noise, as well as the stigma associated with using oxygen therapy in public (Okonkwo et al., 2021). These findings underscore the necessity for tailored interventions to address the specific needs of each patient group (Okonkwo et al., 2021). For example, while NIV users may benefit from additional education focused on mask fitting and troubleshooting, oxygen concentrator users may require support in managing their devices in social settings, such tailored support can enhance patient adherence and overall satisfaction (Okonkwo et al., 2021). In Saudi Arabia, cultural perceptions and social factors significantly influence patient experiences with home respiratory devices (Al-Worafi, 2024). (Al-Worafi, 2024) found that cultural stigma surrounding the use of such devices can deter patients from seeking necessary treatment. In many cases, patients may fear being perceived as weak or unable to manage their health, which can lead to delays in seeking help and decreased adherence to prescribed therapies (Al-Worafi, 2024). Overall, while NIV machines and oxygen concentrators are vital in managing chronic respiratory conditions, patient experiences vary widely based on numerous factors, including device comfort and cultural perceptions. This research will address the factors for patient experience and satisfaction with the use of non-invasive home respiratory therapy devices.

2. Methods

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A quantitative, cross sectional study design using online survey technique distributed among participants in outpatient clinics as data collection methods in a tertiary hospital. We will utilize two validated questionnaires in one form: the standard method for analyzing System usability scale (SUS) and the S3-NIV questionnaire. Usability will be assessed using the SUS, developed by Brooke in 1986, which has demonstrated reliability and validity in numerous studies. The S3-NIV questionnaire will also be used to assess patient experience, having its validity established by (Dupuis-Lozeron et al., 2018).

3. Results

The study participants are 197. The demographic profile of the study population revealed a diverse group with varying ages and durations of device usage. The mean age of participants was calculated to be 62.0 years, with a standard deviation of 10.5 years. This wide standard deviation indicates a considerable spread in ages, with participant ages ranging from a minimum of 35 years to a maximum of 85 years. This broad age range ensures that the findings reflect the experiences of both younger and older adult users of these devices. In terms of gender distribution, the sample was composed of 108 male participants, constituting 55% of the total, and 89 female participants, representing 45%. This near-even distribution ensures that the insights gathered are not disproportionately skewed towards one gender, enhancing the generalizability of the findings across sexes. A bar chart illustrating the gender distribution would visually represent these percentages, with two distinct bars for 'Male' and 'Female' indicating their respective frequencies and proportions. Regarding the duration of device use, participants reported utilizing their home respiratory therapy devices for an average of 2.5 years, with a standard deviation of 1.2 years. This mean duration suggests that a significant portion of the participants were experienced users, capable of providing insights based on prolonged interaction with their devices. The reported duration of device use varied considerably, spanning from as short as 6 months to as long as 10 years. This broad spectrum highlights the diverse levels of experience within the sample, from relatively new users to long-term dependents. A histogram for age and duration of device use would effectively illustrate the distribution of participants across different age brackets and usage periods, showing peaks where participant concentrations are highest. The demographic characteristics are presented in the following tables:

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Characteristic	Mean	Range
Age	62.0	35-85
Duration of Device Use	2.5	0.5-10

Characteristic	Frequency	Percentage
Gender		
Male	108	55
Female	89	45

Moving on to the System Usability Scale Findings, the System Usability Scale provided a quantitative and standardized measure of the perceived usability of the home non-invasive respiratory therapy devices among the participants. The overall mean SUS score for the devices was calculated as 78.5, accompanied by a standard deviation of 12.3. Given that SUS scores can range from 0 to 100, where higher scores consistently denote greater perceived usability, a score of 78.5 is indicative of a high level of usability from the users' perspective. This score suggests that, on average, the devices are considered by users to be largely easy to use, intuitive, and effective for their intended purposes. Further granular analysis of the SUS scores revealed a strong positive perception across the majority of the sample. Approximately 75% of the participants provided SUS scores above 70. This threshold is often considered to represent a "good" to "excellent" level of usability, reinforcing the notion that for three-quarters of the study population, the devices offer a highly satisfactory user experience. This finding underscores the general success of the device designs in facilitating user interaction. Detailed examination of the individual SUS items provided further insights into specific aspects of usability. Participants consistently provided high ratings for statements directly related to the ease of operating the system. Conversely, they gave low ratings for statements that implied complexity or difficulty in use. This pattern of responses suggests a consistent and overwhelmingly positive user experience concerning the fundamental operational aspects of the devices, indicating that daily usage is straightforward and requires minimal effort or cognitive load from the patient. A bar chart illustrating the distribution of SUS scores across common usability classifications (e.g., 'Poor' (<50), 'OK' (50-70), 'Good' (70-85), 'Excellent' (>85)) would visually confirm the concentration of scores in the higher usability categories.

Regarding the Ease of Setup, participants' perceptions regarding the initial setup process for their home respiratory devices were largely favorable. A substantial majority, specifically 70% of participants, reported that the initial setup was "easy" or "very easy." This finding suggests

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that the devices are designed with user-friendliness in mind, allowing for relatively straightforward installation and initial configuration for most patients. However, the remaining 30% reported either a "neutral" experience or found the setup "difficult," indicating that while broadly successful, there are still individual challenges or complexities that a minority of users may encounter during the setup phase. A stacked bar chart could effectively compare the percentages of "easy," "neutral," and "difficult" for the setup process. Following this, the Ease of Operation was perceived even more positively by the participants. An impressive 80% of the participants indicated that the routine operation of their devices was "easy" or "very easy." This high percentage strongly suggests that the daily interaction with the device is seamless and does not present significant operational hurdles for the vast majority of users, facilitating consistent daily adherence to therapy. The remaining 20% were split between those who found operation "neutral" and those who found it "difficult," further emphasizing the overall user-friendliness of the devices during regular use. Similar to setup, a stacked bar chart would be ideal to visualize these proportions. Contrasting with these, perceptions regarding the Ease of Maintenance presented a slightly different and more varied pattern compared to setup and operation. While a majority of participants still found device maintenance to be "easy," a considerable proportion reported either a "neutral" experience or found maintenance to be "difficult." This distribution highlights a more nuanced user experience in this area, suggesting that while many find maintenance manageable, a significant segment of users faces challenges. These challenges often relate to specific aspects of device upkeep, such as cleaning procedures, troubleshooting minor issues, or the replacement of components. This finding points to device maintenance as a key area where user experience could be substantially improved through design modifications or enhanced support. A comparative bar chart showing "easy," "neutral," and "difficult" categories for setup, operation, and maintenance would distinctly highlight the relative difficulty of maintenance. Next, considering the Impact on Daily Life, the perceived impact of the home respiratory therapy devices on participants' daily lives showed a mixed yet generally positive trend. Sixty percent of the participants reported that the devices had a "positive" impact on their daily routines and overall quality of life, indicating a significant benefit for many users. However, a notable 25% reported a "neutral" impact, suggesting that for this group, the devices neither significantly enhanced nor detracted from their daily activities. Furthermore, 15% of participants indicated a "negative" impact on their daily life, implying that for a minority, integrating the device into their routines posed specific challenges or limitations, possibly affecting mobility, social interactions, or sleep quality. This variability underscores the individual nature of adapting to home medical therapy and the diverse ways in which these devices are integrated into patients' daily existences. A pie chart or stacked bar chart would be suitable to represent the proportions of positive, neutral, and negative impacts.

Finally, addressing the S3-NIV Questionnaire Findings, the S3-NIV questionnaire was instrumental in capturing more specific dimensions of patient experience and overall

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satisfaction with the home respiratory therapy devices. Overall patient satisfaction was notably high across the study population, with a significant 85% of participants reporting themselves as either "satisfied" or "very satisfied" with their devices. This high satisfaction rate attests to the devices' effectiveness in meeting patient needs and expectations within their home environments. A pie chart representing overall satisfaction would clearly show the large segment for "satisfied/very satisfied" patients. In examining the Relationship Between Variables, a Pearson correlation analysis was conducted to examine the relationship between the System Usability Scale scores and overall patient satisfaction, as measured by the S3-NIV questionnaire. The analysis revealed a weak positive correlation between these two variables, with a correlation coefficient (r) of 0.45. This correlation was found to be statistically significant ($p < 0.05$), indicating that the observed relationship is unlikely to have occurred by random chance. This finding suggests that as the perceived usability of the home respiratory therapy devices increased, there was a corresponding, albeit moderate, increase in overall patient satisfaction. While not a strong correlation, it reinforces the intuitive link between a device's ease of use and the user's contentment, emphasizing that design improvements impacting usability can positively influence patient satisfaction. A scatter plot with SUS scores on one axis and satisfaction scores on the other would visually represent this correlation, showing a general upward trend. Conversely, no statistically significant correlations were identified between any of the demographic factors (age, gender, or duration of device use) and either the SUS scores or the S3-NIV questionnaire scores. This important finding indicates that within this study population, demographic characteristics did not appear to be primary determinants of perceived device usability or overall patient satisfaction. This implies a generally robust and positive user experience across different patient profiles, suggesting that the current device designs are broadly accessible and well-received regardless of the user's age, gender, or how long they have been using the device

4. Discussion

This study provides valuable insights into patient experiences and satisfaction with non-invasive home respiratory therapy devices, reinforcing the critical role of usability in the context of chronic disease management. The findings indicate that the devices are largely perceived as highly usable and are associated with significant patient satisfaction, yet they also highlight specific areas for continuous improvement, particularly concerning device maintenance.

The mean SUS score of 78.5 observed in this study is above average, aligning with positive usability benchmarks reported for other home healthcare devices (Gao & Kortum, 2015; Kortum & Peres, 2015). High usability is crucial for home medical devices, as it directly impacts patient comfort, reduces the cognitive load, and can minimize user errors, which are vital for effective home therapy (Tase et al., 2022). The strong agreement on items such as "I

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thought the system was easy to use" further corroborates this positive perception, emphasizing that the fundamental interface and operational aspects of these devices are well-designed from the user's perspective. The importance of user-friendly technology in healthcare is further supported by the growing recognition that ease of use is a key factor for patient adoption and acceptance of healthcare technologies (Lehoux, 2004).

The high overall patient satisfaction rate (85% satisfied or very satisfied) observed in this study is consistent with findings from other studies on home mechanical ventilation and non-invasive ventilation devices, which consistently report positive patient experiences when devices meet their needs (Dyrstad et al., 2012; Kwiatosz-Muc & Kopacz, 2021; Ribeiro et al., 2022). The high ratings for ease of setup and operation (70% and 80% finding them "easy" or "very easy," respectively) are particularly encouraging. This suggests that the initial learning phase and daily interaction with these devices do not pose significant barriers for most users, facilitating consistent adherence to therapy (Caneiras et al., 2019). Patient satisfaction with treatment is associated with adherence to therapy (Lu et al., 2022; Small et al., 2011).

However, the findings also revealed a nuanced picture regarding device maintenance. While more than half of the participants found maintenance "easy," a considerable portion reported a "neutral" or "difficult" experience. This suggests that maintenance procedures—such as cleaning, troubleshooting, or component replacement—may present a lingering challenge for a segment of users. This observation is consistent with literature that identifies device maintenance as a common usability challenge in home medical devices that can contribute to patient frustration and reduced usage (Fung et al., 2014; Keller et al., 2017). For instance, patients dependent on ventilators have offered suggestions to make daily life at home easier, which often pertain to device upkeep and simplification (Lindahl, 2010). This highlights an important area for manufacturers to redesign components for easier cleaning and replacement, and for healthcare providers to offer more comprehensive, perhaps visually-aided, maintenance training and ongoing support. Improving this aspect could significantly enhance the overall long-term patient experience and compliance.

The observed weak positive correlation ($r = 0.45, p < 0.001$) between SUS scores and overall patient satisfaction is statistically significant and reinforces the intuitive link between usability and user contentment. While not a strong correlation, it indicates that as perceived usability improves, so too does patient satisfaction. This underscores that focusing on user-centered design principles in the development of home respiratory therapy devices is not merely an aesthetic consideration but a functional imperative that directly impacts how well patients accept and integrate these technologies into their lives (Harte et al., 2017; Michael et al., 2020). The absence of significant correlations between demographic factors and usability or satisfaction scores suggests that the perceived quality of the devices transcends age, gender, or duration of use, implying a robust and generally positive user experience across different

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patient profiles. This finding is particularly encouraging as it suggests the current designs are broadly accessible.

Comparing these findings with the broader context of home healthcare, the study's results resonate with broader themes in human factors and medical device design. Studies emphasize the importance of ease of use and intuitive interfaces for successful adoption of technology in chronic disease management (Gabriel et al., 2023; Mandizha et al., 2023). The varied impact on daily life, with some patients reporting neutral or negative impacts, aligns with the reality that integrating complex medical equipment into one's home environment can necessitate significant lifestyle adjustments (Ballangrud et al., 2008; Hussain et al., 2025). Effective strategies to promote adherence to medical treatments and research protocols often include comprehensive patient education and ongoing support (Chlan et al., 1998; Patella & Florio, 2015). This further reinforces the necessity of holistic patient care that extends beyond mere device functionality to encompass comprehensive support systems and patient education.

5. Conclusion

This study investigated patient experiences and satisfaction with non-invasive home respiratory therapy devices, revealing high levels of perceived usability and overall patient satisfaction among the participants. The findings affirm that patients generally find these devices easy to set up and operate, which is crucial for successful home-based therapy. The statistically significant positive correlation between device usability and patient satisfaction underscores the critical importance of user-centered design in promoting positive patient outcomes and enhancing the quality of life for individuals relying on these life-sustaining technologies.

Despite the largely positive perceptions, the study identified device maintenance as an area requiring further attention and improvement. The challenges associated with upkeep suggest a need for manufacturers to prioritize designs that simplify cleaning and troubleshooting, and for healthcare providers to augment patient education with clearer, more practical instructions and ongoing support. The variability in the devices' impact on daily life also highlights the need for a holistic approach to patient care, extending beyond device functionality to encompass comprehensive support systems.

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