Six-Minute Walk Test as a Discharge Criterion and Predictor of Three-Month Readmission in Pulmonary Medicine Patients.

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ABSTRACT

Background: The six-minute walk test (6MWT) is a commonly used tool for measuring functional capacity and predicting outcomes in respiratory disease patients.

Objective: To determine the three-month readmission rate among patients who have completed and those who have not completed the 6MWT at hospital discharge.

Methods: A prospective observational study was carried out at a tertiary care hospital between June and August 2024 with, 250 respiratory disease patients admitted through the Emergency Department or OPD to the respiratory ward. All patients received a 6MWT before discharge, per ATS guidelines, which measures six-minute walk distance (6MWD), oxygen supplementation, and Borg scale scores for dyspnea and fatigue. Readmission was monitored for three-month periods through OPD visits.

Results: Out of 250 patients, the mean age was 65.2 ± 14.0 years, and 46.8% were male. 80.4% of patients passed the test, and 19.6% failed. Oxygen supplementation was required by 28.8%, with comparable pass rates in both groups. The three-month readmission rate was 12.4%, with significantly higher odds among those patients who failed (34.7%, OR=6.94) versus those who passed (7.0%). Patients walking less than 300 meters had a 4.52-fold higher readmission risk, and each 100-meter increase in 6MWT reduced odds by 20% (OR=0.8). Most patients reported minimal dyspnea (49.2%) and fatigue (44.4%).

Conclusion: The 6MWT served as an important assessment for the functional capacity of patients with respiratory disease. Failure to complete the test (OR=6.94) or walking less than 300 meters (OR=4.52) considerably increased the risk of readmission. The test is, therefore, a useful predictor for determining readmission risk and discharge criteria. Further research is required to explore interventions that will enhance the functional capacity and prevent readmission.

Keywords: 6-minute walk test, discharging criteria, functional capacity

INTRODUCTION

Measurement of exercise capacity is an integral element in the assessment of patients with cardiopulmonary disease. The 6-minute walk test (6MWT) measures the functional capacity and response to treatment, and is considered prognostic in various cardiopulmonary conditions[1]. The 6MWT is a practical, straightforward, test requiring only a 100-ft hallway for the walk, no other equipment, and minimal training of technicians. This test measures the distance that a patient can quickly walk on a flat, hard surface in 6 minutes (the 6MWD). It evaluates the global and integrated responses of all the systems involved during exercise, including the pulmonary and cardiovascular systems, systemic circulation, peripheral circulation, blood, neuromuscular units, and muscle metabolism[2]. The reproducibility of the 6MWT is very good in the hands of physicians, nurses, or any other operator who performs it regularly based on protocol[3].

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According to ATS guidelines, the 6MWT can assess cardiorespiratory function in various situations such as obstructive lung diseases, interstitial lung disease, pulmonary hypertension, heart failure, post-lung volume reduction surgery, etc.[2]. There are some circumstances which contraindicate the 6MWT- an acute myocardial infarction or unstable angina (acute), any symptomatic or hemodynamically unstable arrhythmias, acute pericarditis or myocarditis, acutely uncontrolled decompensated HF (acute pulmonary edema), acute pulmonary embolism, suspected dissecting aneurysm, severe hypoxemia at rest or acute respiratory failure, an acute non-cardiopulmonary disorder that may affect exercise capacity or worsen with exercise (e.g., infection, renal failure, or thyrotoxicosis), or a mental impairment that precludes cooperation. The relative contraindications include a resting heart rate exceeding 120 beats/min, systolic blood pressure above 180 mmHg, or diastolic blood pressure beyond 100 mmHg. However, one should terminate the test regardless of the conditions stated if chest pain, intolerable dyspnea, leg cramps, diaphoresis, or the patient's report of not feeling well[2,4].

The 6-minute walk test (6MWT) is an easily accessible and well-accepted measure of the functional capacity for patients with respiratory disease. Although the cardiopulmonary exercise test (the maximal exercise test) is the gold standard for assessing exercise capacity in respiratory disease patients, 6MWT (a submaximal exercise test) adds valid information about the patient's functional status related to the performance of their daily activity[5].

We aim to identify possible associations between 6MWD with other measures of functional status and determinants of 6MWD in respiratory patients, as well as to review the prognostic role of 6MWT with regard to readmission to hospital and mortality.

METHODS

Study design and sample

A prospective observational study was carried out at a tertiary care hospital in Nepal from June to August 2024. Ethical approval was obtained from the Institutional Review Board (IRB) of NHRC.

Inclusion criteria include participants aged 18- 85 years. Patients were admitted to the respiratory medicine ward. Exclusion criteria included patients aged < 18 years, non-respiratory patients, patients admitted to the ICU, patients who did not give consent, physically disabled patients, patients with vascular and musculoskeletal abnormalities, and any recent thoracic and abdominal surgery.

Variables

Age, gender, 6MWTD, oxygen supplementation, Borg scale scores. Readmission data were obtained from hospital admission records and confirmed through OPD follow-up visits.

Six-minute walk distance

The 6MWT was carried out as per the guidelines of the American Thoracic Society (ATS) of 2002, ensuring standardization and reliability of the test results. The test was performed indoors along a flat and straight corridor, with a length of 30 meters as a walking course.

The participants were asked to wear comfortable clothing and shoes appropriate for walking. For a morning or early afternoon test, a light meal was allowed. The participants were asked to avoid vigorous exercise two hours before the test. After a proper explanation and demonstration by the research team, participants were asked to walk at their own pace for six minutes after a resting period of 10 minutes. No warm-up periods were allowed. Part A of the ATS-SMWT worksheet was completed before the Stimulated Modified Walking Test (SMWT) (see Table 1). Part B was composed of the pre-walk Modified Borg Scale for Dyspnea (MBSD), heart rate (HR), blood pressure (BP), and oxygen saturation (SpO2). The 5 Stimulated Modified Walking Distance (SMWD), post-walk vitals, SpO2, and MBSD were recorded in all subjects after the completion (see Table 2). None of the participants needed to terminate the test or rest during the test due to normal health status. Volunteers who desaturated during the test below 90% were excluded at the time of re-coding the worksheet.

Table 1: Six-Minute Walk Test Form

APPENDIX

The following elements should be present on the 6MWT worksheet and report:

Lap counter: _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Patient name: _____ Patient ID# _____

Walk # _____ Tech ID: _____ Date: _____

Gender: M F Age: ____ Race: ____ Height: ___ft ____in, ____ meters

Weight: _____ lbs, _____kg Blood pressure: _____ / _____

Medications taken before the test (dose and time): _____

Supplemental oxygen during the test: No Yes, flow _____ L/min, type _____

	Baseline	End of Test
Time	___:___	___:___
Heart Rate	_____	_____
Dyspnea	____	____ (Borg scale)
Fatigue	____	____ (Borg scale)
SpO_2	____ %	____%

Stopped or paused before 6 minutes? No Yes, reason: _____

Other symptoms at end of exercise: angina dizziness hip, leg, or calf pain

Number of laps: ____ (×60 meters) + final partial lap: _____ meters =

Total distance walked in 6 minutes: _____ meters

Predicted distance: _____ meters Percent predicted: _____%

Tech comments:

Interpretation (including comparison with a preintervention 6MWD):

Table 2: Borg Scale

0	Nothing at all
0.5	Very, very slight (just noticeable)
1	Very slight
2	Slight (light)
3	Moderate
4	Somewhat severe
5	Severe (heavy)
6	
7	Very severe
8	
9	
10	Very, very severe (maximal)

Sample size

The total sample size estimated was 250.

(n) = [z2. p (1-p)]/d2 where

z = critical value, which is equal to 1.96 for a confidence level of 95 %

p = prevalence of respiratory patients in Nepal Mediciti hospital, 127 per thousand admissions {776 respiratory patients out of 6098 total admissions of those at or above 18 years}

d = absolute sampling error that can be tolerated, and it is fixed at 5%.

Statistical analysis

The Chi-square test is used to compare the outcomes (readmission rates between the pass vs fail group or the oxygen vs non-oxygen groups). An independent t-test is used to compare continuous variables (6MWD between oxygen and non-oxygen groups. Logistic regression is used to assess the association between 6MWT performance (pass/fail or 6MWD, age, or gender). Correlation analysis is used to explore the relationships between 6MWD and Borg scale scores. SPSS software (V27.0, SPSS Inc., Chicago, IL, USA) is used for statistical and receiver operating characteristic (ROC) analysis.

RESULT

A total of 250 patients were analyzed in this study, with a mean age of 65.2 ± 14.0 years. The study population comprised 46.8% males (n=117) and 53.2% females (n=133) (Figure 1).

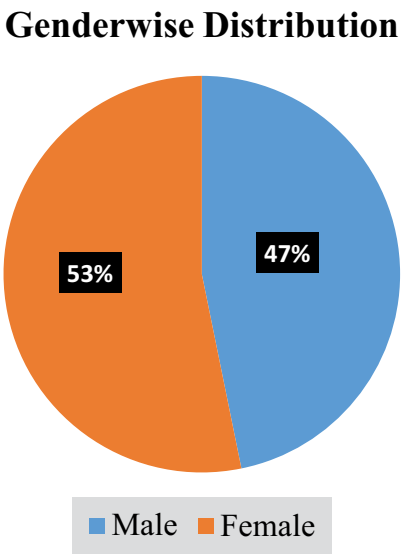

***Figure 1**: Gender-wise distribution of patients.*

Among the 250 patients who underwent the six-minute walk test (6MWT), 80.4% (n=201) passed the test, while 15.6% (n=49) did not (Figure 2).

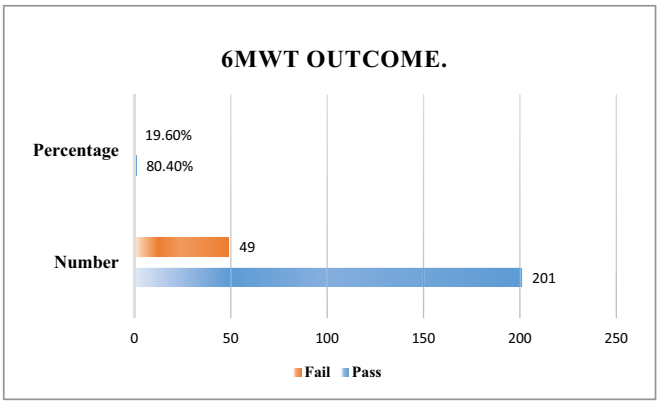

***Figure 2:** Distribution of 6MWT outcome.*

Additionally, 71.2% (n=178) of patients did not require oxygen supplementation during the 6MWT, while 28.8% (n=72) did (Figure 3).

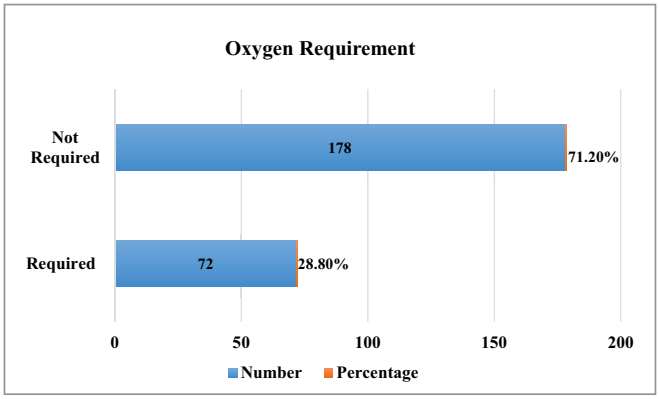

***Figure 3:** Distribution of oxygen requirement during the test.*

Out of 178 patients who did not require oxygen supplementation during the six-minute walk test (6MWT),

84.3% (n=150) passed the test, and 15.7% (n=28) did not (Table 3).

Table 3: Distribution of pass/fail outcomes among patients not requiring oxygen supplementation.

Patient pass/fail (No oxygen)	Number	Percentage
Pass	150	84.3%
Fail	28	15.7%
Total	**178**	**100%**

Similarly, among the 72 patients who require oxygen supplementation during the six-minute walk test (6MWT), 84.7% (n=61) passed, while 15.3% (n=11) did not (Table 4).

Table 4: Distribution of pass/fail outcomes among patients requiring oxygen supplementation.

Patient pass/fail (with oxygen)	Number	Percentage
Pass	61	84.7%
Fail	11	15.3%
Total	**72**	**100%**

Regarding readmissions, out of 250 patients who underwent the six-minute walk test (6MWT), 12.4% (n=31) of the patients were readmitted to the hospital, likely due to poor performance or worsening symptoms, indicating the need for further care. The remaining 87.6% (n=219) were not readmitted. These patients may have recovered after initial treatment, been transferred to other healthcare facilities, or may have passed away at home or in other facilities (Figure 4).

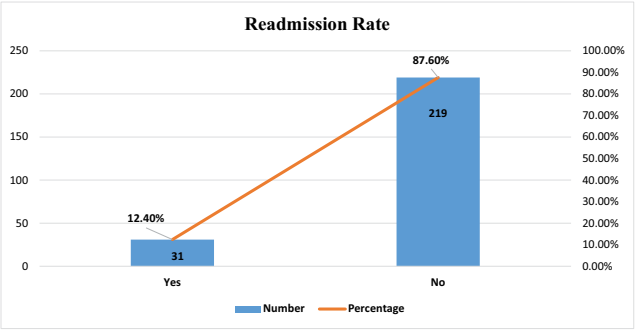

Figure 4: *Readmission rate post 6MWT.*

Out of 201 patients who passed the test, the vast majority, 93% (187), did not require hospital readmission, suggesting that passing the test is associated with a lower risk of readmission, whereas 7% (14) of patients required admission (Table 5).

Table 5: Distribution of readmission or not among patients who have passed the test.

Readmission	Number	Percentage
Yes	14	7%
No	187	93%
Total	**201**	**100%**

Out of 49 patients who failed the test, a significantly higher proportion, 34.7% (32), were readmitted compared to those who passed, indicating that failing the test is associated with a higher readmission risk (Table 6).

Table 6: Distribution of readmission or not among patients who have failed the test.

Readmission	Number	Percentage
Yes	17	34.7%
No	32	65.3%
Total	**49**	**100%**

Out of 250 patients, 64.8% (n=162) covered a distance of 300 meters or more, while 35% (n=88) of patients walked less than 300 meters. The average SMWD is 312 meters. This suggests that most patients had adequate functional capacity, potentially correlating with better clinical outcomes (Table 7).

Table 7: Distance covered during 6MWT.

Six-minute walk test (6MWT)	Number total distance traveled	Percentage
≥ 300 meters	162	64.8%
< 300 meters	88	35.2%
Total	**250**	**100%**

Almost half of the patients (49.2%) reported no breathlessness (score 0.0), indicating a significant proportion with minimal symptoms. The percentages decrease as the score increases. 10% reported very, very slight breathlessness, and only 0.4% reported very severe breathlessness at score 9, with no patients reaching the maximum score of 10 (Table 8).

Table 8: Dyspnea (Borg Scale) Distribution

Score	Number of Patients	Percentage (%)
0	123	49.2
0.5	25	10
1	26	10.4
2	24	9.6
3	19	7.6
4	16	6.4
5	6	2.4
6	7	2.8
7	3	1.2
8	0	0
9	1	0.4
10	0	0

A majority of the patients (44.4%) reported no fatigue (score 0.0), with 12.8% reporting very, very slight fatigue and only 0.4% reporting very severe fatigue at score 9, again with no patients at the maximum score of 10 (Table 9).

Table 9: Fatigue (Borg Scale) Distribution

Score	Number of Patients	Percentage (%)
0	111	44.4
0.5	32	12.8
1	29	11.6
2	28	11.2
3	15	6
4	14	5.6
5	9	3.6
6	5	2
7	6	2.4
8	0	0
9	1	0.4
10	0	0

Of the 250 patients, 80.4% (n=201) passed the 6MWT, and 19.6% (n=49) failed, based on the American Thoracic Society (ATS) guidelines. The overall readmission rate was 12.4% (n=31), with 7% (n=14) of passers readmitted compared to 34.7% (n=17) of those who failed. Logistic regression revealed that failing the 6MWT was associated with significantly higher odds of readmission, Odds Ratio [OR] = 6.94, 95% Confidence Interval [CI]: 3.01–15.98, p < 0.001 (Table 10).

Table 10: Readmission Rates by 6MWT Pass/Fail Status

6MWT	Number of Patients	Readmitted (n, %)	Not Readmitted (n, %)	Readmission Probability
Pass	201	14 (7%)	187 (93%)	7%
Fail	49	17 (34.7%)	32 (65.3%)	34.7%

Patients were categorized based on 6MWD: <300 meters (35.2%, n=88) and ≥300 meters (64.8%, n=162). Logistic regression showed that patients walking <300 meters had significantly higher odds of readmission compared to those walking ≥300 meters (OR = 4.52, 95% CI: 1.89–10.81, p = 0.001). Additionally, when treating 6MWD as a continuous variable, each additional 100 meters walked was associated with a 20% reduction in readmission odds (OR = 0.80, 95% CI: 0.68–0.94, p = 0.007). The area under the curve (AUC) was 0.78 (95% CI: 0.70–0.86), indicating good discriminatory ability. A 6MWD of 300 meters was identified as the optimal cut-off, with a sensitivity of 68% and specificity of 75% for predicting readmission (Table 11).

Table 11: Readmission Rates by 6MWT Category

6MWT	Number of Patients	Readmitted (n, %)	Not Readmitted (n, %)	Readmission Probability
< 300 meters	88	20 (22.7%)	68 (77.3%)	22.7%
≥300 meters	162	11 (6.8%)	151 (93.2%)	6.8%

DISCUSSION

The Six-Minute Walk Test (6MWT) is a validated, practical tool for assessing functional capacity in patients with respiratory diseases. The 6MWT is based on the functional exercise capacity needed for daily activities, usually done at submaximal efforts, by assessing the integrated responses of the pulmonary, cardiovascular, and neuromuscular systems[2]. This study explored the relationship between completing 6MWT and the likelihood of readmission, examining 250 patients admitted to a tertiary care hospital in Nepal. The results underscore the test's feasibility, prognostic value, and potential contribution to discharge planning.

In our study, 80.4% of patients underwent the 6MWT, while 19.6% did not. Our completion rate is well within the completion rates of other previous research that reported, which emphasizes the 6MWT as a feasible and usable tool[4]. Notably, oxygen supplementation required in 28.8% of patients did not significantly impact pass rates (84.3% without oxygen vs. 87.3% with oxygen), supporting ATS guidelines endorsing 6MWT use across respiratory impairment severities[2,6]. However, performance varies by population. For example, Yanamandra et al. noted a 62.26% failure rate in severe COVID-19 patients[7], underscoring disease severity on the impact test.

A key finding of our study was the 12.4% hospital readmission rate within three months among 6MWT patients. Failure to complete the test was associated with a 6.94-fold increased readmission risk (95% CI: 3.01–15.98, p<0.001) compared to those who passed. Similarly, patients walking <300 meters had 4.52-fold greater odds of readmission risk (95% CI: 1.89–10.81, p=0.001) than those achieving ≥300 meters. These thresholds resonate globally. Polkey et al.[8] found that a 6MWD <334m was associated with hospitalization in COPD (OR=3.1). Du Bois et al.[9] noted that >50m 6MWD decline related to mortality in patients with idiopathic pulmonary fibrosis (IPF) (HR=2.37). Lancaster et al.[10] in IPF, also found that a baseline 6MWD of <250 meters or a >50-meter 6MWD decline over 24 weeks is related to increased mortality related to IPF. Similarly, Matos Casano and Anjum et al.[11] found that in chronic obstructive pulmonary disease (COPD), a 6MWD ≤ 350 meters is related to greater exacerbations, hospitalizations, and mortality.

A 64.8% (n=162) of the patients achieved a 6MWD ≥300 meters, a good level of functional capacity, and likely contributed to the low readmission rate. Nishiyama et al.[12] state that the mean 6MWD was 394 meters for ILD; Degano B et al.[13] observed that >500 meters was an indicator of good prognosis for ILD, whereas <300 meters was an indication of poor prognosis. Shrestha SK et al.[14] documented an average of 488.86 ± 86.03 meters (~489 ± 86) for 6MWD in Nepalese patients, reinforcing that a 6MWD ≥ 300 meters supports better outcomes with lower readmission risk.

Our result confirms that failing the 6MWT significantly increases readmission risk (OR=6.94, 95% CI: 3.01-15.98), and a 6MWD <300 meters is associated with a 4.52-fold higher risk compared to ≥300 meters. These results align with established prognostic thresholds. For instance, in COPD, Polkey et al.[7] reported that failing a 6MWD of 334 meters predicted hospitalization, and Degano and Sitbon[12] found that in patients with PAH, a 6MWD <300 meters was associated with poor prognosis. Although the differences in study populations and outcomes prevent direct comparisons of odds ratios, we note that the OR in our study for the 300-meter threshold (OR=4.52) is of a similar order as the hazard ratio of 2.37 for mortality associated with a decline of >50-meters in 6MWD over 24 weeks in patients with IPF[9]. Moreover, the dose-response relationship we observed — each 100-meter increase in 6MWD reducing readmission odds by 20% (OR=0.80, 95% CI: 0.68-0.94) — reinforces the continuous nature of functional capacity as a predictor of outcomes, analogous to the 13% reduction in cardiovascular readmissions per 1 mL/kg/min increase in VO2peak reported by Mikkelsen et al.[6]. The high odds ratio associated with test failure (OR=6.94) reflects the 6MWT's ability to capture multifaceted vulnerabilities beyond walking distance, providing objective criteria for discharge planning and highlighting the need for targeted interventions in high-risk patients.

Among the 250 patients, 31 were readmitted (14 from the pass group, 17 from the fail group), consistent with the 12.4% overall readmission rate. This supports that 6MWT failure predicts higher readmission risk, emphasizing its prognostic value as a discharge criterion. Passing the test is associated with better outcomes, while failure indicates the need for closer monitoring or intervention.

CONCLUSION

The 6MWT is a feasible, well-tolerated, and prognostically valuable tool for assessing the functional capacity of respiratory disease patients. Failure to complete the test (OR=6.94) or walking <300 meters (OR=4.52) significantly elevates readmission risk. The test is, therefore, a useful predictor for determining readmission risk and discharge criteria. Further research is needed to establish standardized 6MWD thresholds for discharge criteria across different respiratory conditions.

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AUTHOR CONTRIBUTIONS

Sanjeet Krishna Shrestha: Conceptualization; methodology; validation; visualization; writing – original draft; writing – review and editing. Saroj Poudel: Data curation; methodology; validation; writing – original draft; writing – review and editing. Rakesh Lama: Data curation, writing – original draft. Rashmi Giri: Writing – original draft. Ashish Karthak: Writing – original draft. Naresh Gurung: Writing – original draft. Summer J Singh: Writing – original draft. Sanjeet Bhattarai: Writing – original draft.

DATA AVAILABILITY STATEMENT

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

CONFLICTS OF INTEREST STATEMENT

The authors declare that they have no conflict of interest to declare.

FUNDING INFORMATION

Not available.

ETHICS CONSIDERATIONS

Ethics approval was obtained from the Ethical Committee of the NHRC. Written informed consent was obtained.

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