# The Quick Walk Test: A Noninvasive Test to Assess the Risk of Mechanical Ventilation During COVID-19 Outbreaks

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The first case of coronavirus disease 2019 (COVID-19) in the Lombardy region of Italy was confirmed in February 2020.[1] Here, the outbreak resulted in the rapid overcrowding of several emergency departments (EDs), where physicians had little or no criteria to decide who needed hospitalization or could be discharged.[2] Several studies described common patterns of symptoms[3–6] (fever, cough, dyspnea, myalgia, fatigue) and chest radiologic findings[3,5] (consolidation, ground-glass opacity, bilateral infiltrations, interstitial abnormalities) in severe and nonsevere COVID-19 patients. While prognostic scores to identify clinical deteriorations have been proposed,[7] they have not been targeted to patients with mild symptoms at ED presentation.

The city of Lodi, in Lombardy, faced one of the first and major epidemic outbreaks in Italy. Here, emergency physicians observed fatigue and syncope in patients after mild efforts, such as few steps. When vital parameters were measured, physicians observed low peripheral oxygen saturation ($SpO_2$) levels, even in patients with normal values at rest. Since one of the characteristics of COVID-19 pneumonia is the discrepancy between relatively well-preserved lung compliance and severely compromised pulmonary gas exchange (hypoxemia without fatigue and hypercapnia),[8] patients with a progressive underlying respiratory failure may still arrive to the ED with mild symptoms.

Hence, the ED team adapted the traditional 6-minute walk test into a quick walk test (QWT), to evaluate the pulmonary impairment of COVID-19 patients. Exercise-induced hypoxemia is commonly used with respiratory diseases, to assess the degree of disability, prognosis, and response to treatments.[9] The 6-minute walk test is the most widely used and consists of the measurement of the distance walked in 6 minutes.[9] The QWT was designed as a walk of 30 to 40 meters at the maximum possible speed for each patient. The distance was considered sufficient to induce detectable hypoxemia in patients with normal parameters at rest but a progressive underlying respiratory failure. Longer walks would have exposed patients to the risk of

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severe hypoxemia and would have been impractical for regular use in EDs during the hyperepidemic stages of the outbreak. Pre- and postexercise $SpO_2$ values were collected. Lodi's ED team shared the idea with the *Fenice* research network[10] and other EDs started using the QWT to identify patients who, during the emergency, needed immediate care or could be discharged.

We studied the prognostic value of the QWT for patients suspected of COVID-19 during an outbreak, focusing on the need for invasive mechanical ventilation (MV) within 15 days from the first ED access as outcome. As median times from illness onset to clinical deterioration of 8.4[4] or 14.5[5] days have been reported, a follow up of 15 days was chosen to capture most of the severe clinical deteriorations, while excluding events that were not directly related to the severity of the COVID-19 infection.

We evaluated three different criteria to interpret the results of the QWT. The test was considered positive in case of:

1. Decrease in $SpO_2 \geq 3\%$, the minimum difference that can be reliably evaluated with common pulse oximeters.
2. Decrease in $SpO_2 \geq 5\%$, a more conservative cutoff.
3. Postexercise $SpO_2 \leq 90\%$, corresponding to a $PaO_2$ of about 60 mmHg, the commonly used threshold for respiratory failure.

We retrospectively collected data on the patients admitted to the ED of four hospitals in Lombardy: Maggiore Policlinico and San Carlo Borromeo (Milan), Maggiore (Lodi), and Papa Giovanni XXIII (Bergamo). In these EDs, the policy was to perform the QWT on all nonurgent patients suspected of COVID-19 able to walk. Patients with $SpO_2 \geq 95\%$ at rest at ED admission and normal vital signs were considered as nonurgent. Patients were suspected of COVID-19 in case of flu-like syndrome (myalgias, cough/dyspnea or respiratory symptoms, fever, asthenia).

All the patients who visited the participating EDs between February 25 and April 30, 2020, satisfied these criteria and performed the QWT were eligible for this study. Patients with chronic obstructive pulmonary disease were excluded. The study was approved by the institutional ethics committee Milano Area 2 (study code EC-COVID/2020) who, due to the retrospective nature of the study, dispensed from the requirement of informed consent.

Of the 937 ED patients with a suspected COVID-19 infection who performed the QWT, the outcome was available on 812 (86.7%). The selection of the patients is illustrated in Data Supplement S1, Figure S1 (available as supporting information in the online version of this paper, which is available at http://onlinelibrary.wiley.com/doi/10.1111/acem.14180/full), where we also describe the patients at ED admission (Data Supplement S1, Table S1). Within 15 days from the ED admission, CPAP was required by 32 patients (3.9%) and MV by six (0.7%). For these six patients, MV was started between the third and ninth days from ED presentation. Four patients (0.5%) died.

Table 1 reports the results of the QWT, according to the three proposed criteria to consider the test positive. Regardless of the criterion, the percentage of patients with a positive test result among those with a poor outcome (analogous to the sensitivity of diagnostic tests), was 83.3% (95% confidence interval [CI] = 35.9% to 99.6%). Instead, the percentage of patients

Table 1
Interpretation of the QWT According to the Different Criteria in the Groups of Patients Who Were and Were Not Mechanically Ventilated

| QWT Criteria | MV ($n$ = 6) | No MV ($n$ = 806) | Performance of the Test |
|---|---|---|---|
| Loss of 3 percentage points after QWT, *N* (column %) | | | |
| Positive | 5 (83.3) | 192 (23.8) | PPV = 2.5% (95% CI: 0.8%–5.8%) |
| Negative | 1 (16.7) | 614 (76.2) | NPV = 99.8% (95% CI = 99.1%–100.0%) |
| Loss of 5 percentage points after QWT, *N* (column %) | | | |
| Positive | 5 (83.3) | 87 (10.8) | PPV = 5.4% (95% CI: 1.8%–12.2%) |
| Negative | 1 (16.7) | 719 (89.2) | NPV = 99.9% (95% CI = 99.2%–100.0%) |
| Post-QWT saturation ≤ 90%, *N* (column %) | | | |
| Positive | 5 (83.3) | 53 (6.6) | PPV = 8.6% (95% CI: 2.9%–19.0%) |
| Negative | 1 (16.7) | 753 (93.4) | NPV = 99.9% (95% CI = 99.3%–100.0%) |

MV = mechanical ventilation; NPV = negative predicting value; PPV = positive predicting value; QWT = quick walk test.

with a negative test among those with a good outcome (analogous to the specificity) was 76.2% (95% CI = 73.1% to 79.1%) with the first criterion, 89.2% (95% CI = 86.9% to 91.3%) with the second, and 93.4% (95% CI = 91.5% to 95.0%) with the third. The positive predictive values (PPVs) ranged from 2.5% to 8.6%, and the negative predictive values (NPVs), from 99.8% to 99.9%.

Data Supplement S1, Section S1, describes two sensitivity analyses to assess the robustness of the estimates to the exclusion of the patients with missing outcome, computing test ignorance regions and using a Bayesian model. The results were consistent with what emerged from the main analysis and did not raise concerns about such an exclusion.

The first result emerging from our data is the very small proportion of the study patients who showed poor short-term outcomes, despite the high fluxes of patients and the lack of evidence about effective treatments. These results reassure on the overall good prognosis of COVID-19 patients in nonsevere conditions and normal $SpO_2$, confirming what observed in previous studies.[3]

Despite the moderately high proportion of QWT-positive results among the MV patients (sensitivity = 83.3%), this proportion was estimated with low precision, due to the low incidence of MV. The sole false-negative result pertained to a patient who did not undergo MV immediately after visiting the ED. He tested positive for COVID-19, but the chest X-ray was not suggestive for pneumonia. He was intubated in a subsequent hospital access, 9 days after the first visit, and survived. Accordingly, we believe that the true proportion of patients who are incorrectly classified by the QWT as not at risk of rapid worsening may be even lower than our estimate. Further investigations are deemed essential to verify our conjecture. Conversely, our data provide strong evidence of a very high proportion of patients testing negative at the QWT among those who have not undergone MV (specificity). This proportion was higher than 90% in the version of the test based on the postexercise $SpO_2$.

These results, in combination with the low incidence of poor outcomes and the related very high NPV, suggest that the considered COVID-19 patients may be safely discharged home or hospitalized in low-intensive regimens if testing negative at the QWT. This is essential to optimally allocate the finite resources during COVID-19 outbreaks. Notwithstanding the low PPVs of the three versions of QWT, which may be partially explained by the very low incidence of MV, the best performing version of the test identified a subgroup where the risk of MV was 10 times higher than the full cohort (8.6%/0.7% = 11.7). Given the low severity of the considered cohort, patients testing positive to the QWT should be monitored closely, on high-intensity beds, or with appropriate home-care systems, depending on resource availability.

Such conclusions should be generalized with care. First, the test was evaluated in the hyperepidemic stage of the outbreak, when the majority of suspected cases were confirmed. The performance of the test would likely be different if the eligibility criteria had to be applied to low-prevalence settings, where the number of COVID-19 patients among those with aspecific signs and symptoms is small. Second, ED presentation patterns differ across countries, given the heterogeneity of access to and utilization of the health care systems and of restrictions during the pandemic. These comments warrant further evaluations of the QWT in regions and countries diversely affected by COVID-19 outbreaks.

The main limitation of our study is the fact that the test was not administered to all the eligible patients who arrived at the ED in the study period. The centers performed the QWT in an emergency situation, without a formal study protocol, and the outcome was retrospectively collected for this observational study. Unfortunately, we were not able to reconstruct the exact number of eligible patients. Nevertheless, the centers performed the test using the same policy, shared through the *Fenice* network.

In summary, albeit further prospective studies are essential to confirm our findings, we believe the QWT to be promising, because it can be performed rapidly, without specialized equipment and by nonmedical staff, and may have the potential to reliably identify the patients who can be safely discharged home or hospitalized in low-intensive regimens, after the ED visit.

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## APPENDIX A

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## Supporting Information

The following supporting information is available in the online version of this paper available at http://onlinelibrary.wiley.com/doi/10.1111/acem.14180/full

**Data Supplement S1**. Supplemental material.