
# The MESA COPD
# Six Minute Walk Test
# Field Center Manual of Procedures

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**(An Edited Version of the ATS Statement: Guidelines for the Six-Minute Walk Test**
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## BACKGROUND

There are several modalities available for the objective evaluation of functional exercise capacity. The most popular clinical exercise tests in order of increasing complexity are stair climbing, a 6MWT, a shuttle-walk test, detection of exercise-induced asthma, a cardiac stress test (e.g., Bruce protocol), and a cardiopulmonary exercise test. THE 6MWT is easy to administer, better tolerated, and more reflective of activities of daily living than the other walk tests.

The 6MWT is a practical simple test that requires a 100-ft hallway but no exercise equipment or advanced training for technicians. Walking is an activity performed daily by all but the most severely impaired patients. This test measures the distance that a patient can quickly walk on a flat, hard surface in a period of 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. It does not provide specific information on the function of each of the different organs and systems involved in exercise or the mechanism of exercise limitation, as is possible with maximal cardiopulmonary exercise testing. The self-paced 6MWT assesses the submaximal level of functional capacity. Most patients do not achieve maximal exercise capacity during the 6MWT; instead, they choose their own intensity of exercise and are allowed to stop and rest during the test. However, because most activities of daily living are performed at submaximal levels of exertion, the 6MWD may better reflect the functional exercise level for daily physical activities.

## CONTRAINDICATIONS

Absolute contraindications for the 6MWT include the following:

unstable angina during the previous month and myocardial infarction during the previous month.

Relative contraindications include the following:

resting heart rate of more than 120,
systolic blood pressure of more than 180 mm Hg
diastolic blood pressure of more than 110 mm Hg

These are assessed earlier in the MESA COPD visit and also on Item 1 of the 6MWT Completion Form.

## SAFETY ISSUES

Testing will occur in be performed in a location where a rapid, appropriate response to an emergency is possible. Although adverse events are rare and we are excluding participants with clinical cardiovascular disease from MESA COPD, it is helpful to have medical supplies (e.g., albuterol, aspirin, oxygen available in the case of an emergency). Physicians are not required to be present during tests; however, it is helpful if testing occurs in a setting in which medical professionals (e.g., RNs) are available in the case of an emergency. If a patient is on chronic oxygen therapy, oxygen should be given at their standard rate as discussed below.

Reasons for immediately stopping a 6MWT include the following:

1 chest pain
2 intolerable dyspnea
3 leg cramps
4 staggering

5 diaphoresis
6 pale or ashen appearance

Technicians must be trained to recognize these problems and the appropriate responses. If a test is stopped for any of these reasons, the patient should sit or lie supine as appropriate depending on the severity or the event and the technician's assessment of the severity of the event and the risk of syncope. The following should be obtained based on the judgment of the technician: blood pressure, pulse rate, oxygen saturation, and a physician evaluation. Oxygen should be administered as appropriate.

## TECHNICAL ASPECTS OF THE 6MWT

The 6MWT should be performed indoors, along a long, flat, straight, enclosed corridor with a hard surface that is seldom traveled. If the weather is comfortable, the test may be performed outdoors. The walking course must be 30 m in length. A 100-ft hallway is, therefore, required. The length of the corridor should be marked every 3 m. The turnaround points should be marked with a cone (such as an orange traffic cone). A starting line, which marks the beginning and end of each 60-m lap, should be marked on the floor using brightly colored tape.

## REQUIRED EQUIPMENT

1. Countdown timer (or stopwatch)
2. Mechanical lap counter
3. Two small cones to mark the turnaround points
4. A chair that can be easily moved along the walking course
5. Worksheets on a clipboard
6. A source of oxygen
7. Sphygmomanometer
8. Telephone
9. Automated electronic defibrillator (on site)
10. Wrist pulse oximeter (CMS-50F)

## PATIENT PREPARATION

1. Comfortable clothing should be worn.
2. Appropriate shoes for walking should be worn.
3. Patients should use their usual walking aids during the test (cane, walker, etc.).
4. The patient's usual medical regimen should be continued.
5. A light meal is acceptable before early morning or early afternoon tests.
6. Patients should not have exercised vigorously within 2 hours of beginning the test.

## TESTING

1. Testing should be performed about the same time of day to minimize intraday variability.
2. A "warm-up" period before the test should **not** be performed.
3. The patient should sit at rest in a chair, located near the starting position, for at least 10 minutes before the test starts. During this time, check for contraindications (Item 1 on the 6MWT Completion

Form), evaluate for and record supplemental oxygen to be used during the test, and make sure that clothing and shoes are appropriate.
4. Place the wrist oximeter on the patient and turn it on.
5. Measure and record the baseline heart rate and baseline oxygen saturation (SpO2) on the 6MWT Completion Form.
6. Have the patient stand and rate their baseline dyspnea and overall fatigue using the Borg scale. Show the 6MW Borg Scale Form to the patient and ask the patient this:

*"Please grade your level of shortness of breath using this scale."*

Then ask this: *"Please grade your level of fatigue using this scale."*

Record the responses on the 6MWT Borg Scale Form, Item 1, Pre-test.
7. Set the lap counter to zero and the timer to 6 minutes. Assemble all necessary equipment (lap counter, timer, clipboard, Borg Scale, worksheet) and move to the starting point.
8. Instruct the patient as follows:

*"The object of this test is to walk as far as possible for 6 minutes. You will walk back and forth in this hallway. Six minutes is a long time to walk, so you will be exerting yourself. You will probably get out of breath or become exhausted. You are permitted to slow down, to stop, and to rest as necessary. You may lean against the wall while resting, but resume walking as soon as you are able. You will be walking back and forth around the cones. You should pivot briskly around the cones and continue back the other way without hesitation. Now I'm going to show you. Please watch the way I turn without hesitation."*

Demonstrate by walking one lap yourself. Walk and pivot around a cone briskly.

*"Are you ready to do that? I am going to use this counter to keep track of the number of laps you complete. I will click it each time you turn around at this starting line. Remember that the object is to walk AS FAR AS POSSIBLE for 6 minutes, but don't run or jog. Start now, or whenever you are ready."*

9. Position the patient at the starting line. You should also stand near the starting line during the test. Do not walk with the patient (unless you have to hold the oxygen tank). As soon as the patient starts to walk, start the timer.
10. Do not talk to anyone during the walk. Use an even tone of voice when using the standard phrases of encouragement. Watch the patient. Do not get distracted and lose count of the laps. Each time the participant returns to the starting line, click the lap counter once (or mark the lap on the worksheet). Let the participant see you do it. Exaggerate the click using body language, like using a stopwatch at a race.

After the first minute, tell the patient the following (in even tones): *"You are doing well. You have 5 minutes to go."*
When the timer shows 4 minutes remaining, tell the patient the following: *"Keep up the good work. You have 4 minutes to go."*
When the timer shows 3 minutes remaining, tell the patient the following: *"You are doing well. You are halfway done."*
When the timer shows 2 minutes remaining, tell the patient the following: *"Keep up the good work. You have only 2 minutes left."*
When the timer shows only 1 minute remaining, tell the patient: *"You are doing well. You have only 1 minute to go."*

Do not use other words of encouragement (or body language to speed up).

If the patient stops walking during the test and needs a rest, say this: *"You can lean against the wall if you would like; then continue walking whenever you feel able."* Do not stop the timer. If the patient stops before the 6 minutes are up and refuses to continue (or you decide that they should not continue), wheel the chair over for the patient to sit on, discontinue the walk, and note on the worksheet the distance, the time stopped, and the reason for stopping prematurely.

When the timer is 15 seconds from completion, say this: *"In a moment I'm going to tell you to stop. When I do, just stop right where you are and I will come to you."*
When the timer rings (or buzzes), say this: *"Stop!"*
Walk over to the patient. Consider taking the chair if they look exhausted. Mark the spot where they stopped by placing a bean bag or a piece of tape on the floor.

11. Post-test: Record the postwalk Borg dyspnea and fatigue levels and ask this: "What, if anything, kept you from walking farther?"

At the end of the 6-minute exercise, show the 6MW Borg Scale Form to the patient again and ask the patient this: *"Please grade your level of shortness of breath using this scale."* Then ask this: *"Please grade your level of fatigue using this scale"* after reminding them of their grades before the exercise.

12. Measure oximetry and pulse rate from the wrist oximeter on the 6MWT Completion Form and then remove the wrist oximeter and turn it off.
13. Record any symptoms of discomfort at the end of the test on the 6MWT Completion Form.
14. Record the number of complete laps from the counter on the 6MWT Completion Form.
15. Record the additional distance covered (the number of meters in the final partial lap) using the markers on the wall as distance guides. Calculate the total distance walked, rounding to the nearest meter, and record it on the worksheet.
16. Congratulate the patient on good effort and offer a drink of water.
17. Download the data from the wrist oximeter to a local computer after *each* participant (see instructions below).

## SUPPLEMENTAL OXYGEN

If the participant usually uses oxygen supplementation, then continue it for the 6MWT. If they use it only for exercise, do not use it for the 6MWT. If the patient uses oxygen for the walk, the technician should walk behind the patient carrying the oxygen source. Measurements of pulse oximetry should be made after waiting at least 10 minutes after any change in oxygen delivery.

## CONTINUOUS (WRIST) PULSE OXIMETRY DURING 6MWT

**Rationale**

People with moderate to severe lung or heart disease are often limited by low oxygen levels which develop when they exercise. Their oxygen saturation, measured by a pulse oximeter, is often normal at rest, but decreases by more than 4% during exercise (aka exercise-induced desaturation). Therefore, it is worthwhile to measure oxygen saturation (SpO2, along with pulse rate) before a 6MWT (resting baseline), *during exercise*, and for a few minutes after exercise (the recovery period). Previous generations of pulse oximeters were large and suffered from motion-artifact, causing false positive

results for oxygen desaturation. The latest generation of pulse oximeters are very small (mounted on the wrist), much lower cost, record SpO2 and pulse every ten seconds for later downloading to a computer, and have bright, easy to read displays. We have chosen one of these models (the CMS-50F) for this study. It can record up to 24 hours of SpO2 data before its internal memory is full.

**Initial Set-up of the Wrist Oximeter**

*Computer Set-up*

Charge the internal battery using the USB cable and wall charger. Use the mini-CD ROM disk to install the SpO2 Review software on the Window-based PC used for transfer of study data for central review. A green heart logo will be installed on the desktop. Reboot the computer. Select SpO2 Review from your desktop. Select New Session and a new window will open. Select Connection DMS50F. Select Connection COM9. If COM9 is not an option, the USB redirection software did not install correctly. If problems, ask IT for help to install it.

*Oximeter Set-up*

Hold down the white button for about one second to turn on the oximeter. The display will read "Finger Out." Release and then hold down the white button again for another second to get the Main Menu. Tap the same white button briefly to scroll down the menu until the Time is highlighted. Hold down the button to select and set the correct time and date. When "set time" is highlighted, hold down the button until it changes to yes, then tap the button to set the year, month, day, hour, and minute. It's a little trickly, but you will soon get the hang of the menus and settings. Highlight and select Exit to get back to the Main Menu.

*Pilot Test Run and Data Transfer*

Scroll down to Record, hold the white button until it asks "Start Recording?" then tap the button once to highlight Yes, then hold down the white button, and it will say wait, and return you to the Main Menu. Note that Record is now on. After a few seconds, it will say Recording and then the screen will go blank (to conserve the battery).

Plug the grey oximeter finger sensor into the wrist oximeter, noting the faint arrow, which must point upwards. A red light will start blinking inside the rubber finger sensor, awaiting a fingertip.
Attach the oximeter to your wrist, like a watch, then squeeze the grey rubber finger sensor to place it over one fingertip. You will see a bright red light at the tip of your fingernail.
Hold down the white button, scroll down to exit the Main Menu, hold down the button, and you should see a brightly colored display. Your pulse waveform will be at the bottom, your SpO2 in large blue numbers and your pulse in green. An orange bar graph on the far right shows the strength of the pulse signal (aka perfusion index). Verify that REC is displayed in red (along with a flashing red diamond), to indicate that the signal is being recorded. The display normally changes to "Recording... then goes blank after several seconds. To see your pulse again, hold down the white button. Take the grey sensor off your finger for 5-10 seconds, replace it, then walk around for several minutes, then back to your computer (where you spend most of your day).

Take it off your wrist; attach the USB cable to the left side of the oximeter and then to your computer. Select SpO2 Review from the desktop, select New Session the magnifying glass from the bottom bar. Enter a dummy patient ID.

On the Main Menu of the wrist oximeter, scroll down to Usb, then hold down the button until Usb is turned on. A multi-colored light will illuminate on the left side of the oximeter, next to the USB

connector. Scroll to Record, then hold the button and select to stop recording Yes. Scroll down to Upload, then hold down the button until Upload turns on. The Display will say Uploading. If it quickly returns to the Main Menu, and the Upload line says off, the USB connection was unsuccessful. I have had trouble with this connection on some laptops. When the upload is successful, the trend will be displayed. Print the results.

You can view your SpO2 and pulse in real-time on your computer display by turning Usb on and then launching SpO2 Manager (the red heart logo). Select the 1 square at the lower left of the display. Select the duration of the rolling trend display as 1 minute, 10 min, 30 min, or 60 min at the center of the bottom bar.

If the oximeter is not connected to a computer, turn off the Usb interface to save battery power.
You can turn off the alarms and the beeping sound with each pulse by selecting the Alarm menu from the Main Menu.

Scroll down to Power off to conserve battery life when not using the oximeter. It will say Bye Bye.

**Testing Real Participants and Data Transfer**
Repeat the steps above, except that enter the participant ID +/- acrostic when downloading the data. Save the files to one location. A separate file is required for each participant. Email the files once per week to the MESA Coordinating Center (mesadata@u.washington.edu).