

A DEEP DIVE INTO SHUTTLE WALK TESTS

On today's episode, I am continuing the conversation related to field walking tests. A previous episode of LungFIT gave an overview of the 6 minute walk test, which is very commonly-used in pulmonary rehabilitation, and for good reason – it does not require extensive training to administer, it uses minimal resources, and patients can usually understand quite quickly what is expected of them. But there are limitations to the test – and a big one that is particularly relevant to pulmonary rehabilitation are the challenges related to using the test for an accurate exercise prescription. Since the 6MWD is not always a maximal test, patients can self pace when they do the test, it is more challenging to create an exercise prescription that both is effective enough to get a training response, while also providing values that are safe for the participant's to achieve when they do their training program.

Enter the Incremental Shuttle Walk Test, also known as the ISWT. This is the second test that is discussed at length in the European Respiratory Journal publication, entitled: An official European Respiratory Society/American Thoracic Society technical standard: field walking tests in chronic respiratory disease. The corresponding author for that publication is Dr. Anne E. Holland from La Trobe University Clinical School in Melbourne, Australia. This is an open access article, which means it is freely available – and again I will put the link in the show notes.

This paper provides a great guide on how to conduct field tests in pulmonary rehabilitation, and discusses the properties of these different walking tests. Today, I'm going to focus more on the ISWT, but there is also an endurance shuttle walk test as well, which I'll briefly touch on. To start off, the ISWT is a progressive walking test meaning that the patient progressively increases their walking speed until they are unable to walk any faster or continue. This test can last for a maximum of 20 minutes and is reported as the maximal distance, in 10 meter increments, achieved during the test. So the possible values for the ISWT are between 0 (if that person can't achieve at least 10m) to 1020m. The Endurance Shuttle Walk Test, or ESWT, is an extension of the ISWT, but that test is an endurance test. With the ESWT, the patient walks at a pre-determined pace, based on their performance in the ISWT, for as long as possible. Therefore you need the ISWT done first before you can do the ESWT, and the measure you get for the ESWT is time. So for the ISWT you get meters and the ESWT you get time.

How is ISWT test done? You use a 10 meter course that is marked by 2 cones at either end. An audio recording is used to provide the instructions for the test, so it is very standardized, as well as the speed that the patient should be walking during the test by using beeps on the audio recording. You can purchase this recording from Leicester Hospital in the UK, I'll put that link in the shownotes. The recording describes the test, and how the pacing works. The patient has a set period of time to complete the 10 metre length. As the test continues, that period of time gets shorter and shorter, so the patient has to be walking progressively faster and faster. If they are unable to complete the length during the prescribed time, they get a warning to increase their speed. If they are unable to increase their pace, the test is terminated and the distance is recorded. It sounds complicated, but actually it doesn't take long at all for the patient to get the hang of it and gauge their speed according to the level of test. During the test, you need to watch the patient to keep track of the number of lengths the patient has walked to get that distance, as well as their overall status. The test is stopped for one of three reasons: (1) the person watching the patient decides that the patient is not really "fit to continue", it is not safe for them to continue, (2) the patient cannot keep the speed and complete the distance before the beep, (3) the patient states that they can no longer continue. It is important to note that in order for the patient to be considered to be keeping up with the pace, they need to be within 0.5 metres of the cone before the beep.

The ISWT is a maximal test, and so that means it provides some information that is similar to another test, the cardiopulmonary exercise test. The cardiopulmonary exercise test, also known as the CPET, is typically done on a cycle ergometer. In the CPET, the patient pedals at higher and higher resistance until they cannot continue, while exhaled breath gases and other parameters are continuously measured. The CPET is the gold standard for determining maximal exercise capacity. With the ISWT, the patient also increases their workload until they cannot continue. Although you don't get the exhaled breath gas values in the ISWT, the clinician can obtain some very useful measures from that test, including maximal heart rate and lowest oxygen saturation. You can then quite accurately estimate VO_{2peak} from the ISWT, which is helpful when creating an exercise prescription. Therefore, the ISWT is considered a **valid** measure of cardiopulmonary exercise capacity in COPD based on the current literature; however, the validity in other diseased populations is not clear yet – more evidence is needed.

ISWT is also a **reliable** test. Reliability means: if a patient repeats a test within a relatively short time period, and the patient's health itself has not changed, will the result be similar? It also means, if I conduct the test on a patient, then a colleague conducts the test within a specific time period, and again the patient's health itself has not changed in that period, will the result be similar despite two different people conducting the test? And the answer to those questions are yes, research shows that the test results would be similar. It is very reliable.

With respect to the ESWT, this test is conducted based on the results of the ISWT. It's conducted along the same course as the ISWT, but instead of progressively increasing the speed, the patient stays at the same speed for the whole test; however, each patient is given about 1.5 minutes to warm up. The instructions are given from an audio recording like the ISWT, but the patient maintains the same speed for as long as they can, and it is not a slow speed, they are still working at a good pace, but it isn't that maximal pace speed that they achieved when they were doing the ISWT. The reasons for the termination of the test are the same as for the ISWT: (1) the person watching the patient decides that the patient is not "fit to continue", (2) the patient cannot keep up with the required speed, and/or (3) the patient states that they can no longer continue. Research indicates that end-test heart rate and dyspnoea responses for the ESWT are quite similar to a treadmill endurance test that is completed at the same intensity. The reliability and validity of the ESWT have not been studied as extensively as the ISWT, but both these tests responsive to pulmonary rehab exercise interventions.

In the episode on 6MWT, I talked about the learning effect that comes with that test. The first time the test is done, patients are just trying to figure it out, so the distance they achieve may not be their best. If they do the test again in about 30 minutes, they have a better understanding of their overall pacing and often have a higher result. The same is true for the ISWT. It does take patients a practice try to get a sense of how the beeps work, what the pacing is like, therefore like the 6MWT, two tests are required for the shuttle walk tests.

For both the ISWT and ESWT, there are methodological factors that impact performance are still being studied. Both tests have a "fixed" track layout, so we haven't really seen research that says that different alterations to that layout would result in the same test. So the expectation is that you keep the layout as determined in the guidelines. Regarding supplemental oxygen, when the tester carries the oxygen versus the patient, the benefit to the patient increases, but you want to be consistent. If you carried it pre-rehab you want to make sure that you carry it during post-rehab. Regarding the safety of these tests, currently there have not been any adverse events reported in association with either tests, but there is agreement that if the SpO_2 drops below 80%, the tests (either one) should be stopped. And I

think that you would find that with most field tests and most exercise tests, 80% is getting pretty low. The ISWT is a maximal test, so absolute and relative contraindications for exercise testing is consistent with those required for maximal exercise testing. These are listed in Table 4 of the paper, so please review them and confirm your patient is safe for exercise testing.

I'd like to encourage you to review the paper, and consider the ISWT, and perhaps the ESWT, as an exercise test for use in your pulmonary rehab program. The ISWT offers many advantages over the 6MWT, including an estimate of maximal heart rate and workload, which can be used to create individualized exercise prescriptions that are both safe and effective. So, I would really encourage you to give this test a try, see if you can include it in your program. It has quite a lot of utility and it isn't difficult to learn at all. If you'd like to learn more about the test, you can go to the website where you can purchase the test audiotape, which is Leicester Hospital in the UK, I've put that link in the show notes. They have papers posted which report on some of the shuttle walk test studies, as well as order forms. The Australia Lung Foundation has a pulmonary rehabilitation toolkit, which provides more details about the test, including how you can use the test result to create an individualized exercise prescription. I'll put the link of both these sites in the show notes.

Thanks again for listening, and we'll be back soon for another episode of LungFIT!