Developed in collaboration with the Wound Care Champions, Wound Care Specialists, Enterostomal Nurses, and South West Regional Wound Care Program (SWRWCP) members from Long Term Care Homes, Hospitals, and South West CCAC contracted Community Nursing Agencies in the South West Local Health Integration Network.	
Title	**Procedure: Toe Brachial Index (TBI) Testing Using Photo Plethysmography (PPG)**
Background	• Peripheral arterial disease (PAD) is a condition characterized by • decreased blood flow to the limbs secondary to a narrowing or • blockage of the tributary arteries[1] • The presence of PAD is frequently associated with age greater than 70 years, diabetes, high cholesterol and blood pressure, smoking, obesity, physical inactivity, and kidney disease[1-3] • PAD is a predictor for cardiovascular mortality[2] • Depending on the degree of arterial blockage or narrowing, clinical signs of PAD may vary from tingling/numbness in the affected limb, to intermittent claudication, rest pain, ulceration, gangrene, and/or amputation, however; most people with PAD are asymptomatic (two thirds)[4-6] • Ankle Brachial Index (ABI) may be completed in order to assess individuals for PAD, but the results may be inconclusive • Please refer to the document titled "**Procedure: Ankle Brachial Index (ABI) Testing Using Handheld Doppler**" • Inconclusive results can be due to incompressible arteries • TBI can be conducted for PAD evaluation when ABI results are abnormally high
Indications	This procedure is intended to be used by front line registered health care providers to assist with their assessment and management of individuals presenting with a leg or foot ulcer and/or lower limb edema and/or signs of PAD. This procedure should NOT be conducted: • If the person has significant lower leg/wound pain, making them intolerant of the procedure • In the arm of a person with a dialysis fistula or who has had a mastectomy • By a health care provider who has not received training in TBI testing
Procedure	NOTE: The use of the "Procedure: Toe Brachial Index (TBI) Testing Using Photo Plethysmography (PPG)" is but one part of the holistic assessment of an individual presenting with a leg or foot ulcer and/or lower limb edema and/or signs of PAD. **Assessment** 1. Determine whether the performance of this procedure is appropriate for the person presenting to you, i.e. any person with a wound on their leg or foot and/or with lower limb edema and/or signs of PAD, who has not had TBI or equivalent testing conducted in the past six

	months, or if they have, has not had a significant change in the presentation of their limb or wound since the last testing 2. This procedure should be used in conjunction with the "Guideline: The Assessment of People with Diabetic/Neuropathic Foot Ulcers" or "Guideline: The Assessment of People with Leg Ulcers". Check the person's chart to determine if either of these assessments have been completed, and review their contents. If the applicable assessment has not been completed, consider conducting the assessment. 3. Look through the person's chart for any prior ABI/TBI results, for comparison purposes. **Planning** Expected outcomes: a) Information from your TBI assessment will contribute to the completion of the "Interdisciplinary Diabetic/Neuropathic Foot Assessment Form" or "Interdisciplinary Lower Leg Assessment Form", and will help identify if PAD is an underlying cause of the foot/leg wound(s) and/or leg edema/signs of PAD b) Registered nursing staff, in collaboration with other involved health care disciplines and the person with the wound/edema/signs of PAD and/or their SDM/POA C (if applicable), will be able to use the TBI assessment information (along with the holistic foot/lower leg assessment information) to initiate/modify and implement an appropriate, interdisciplinary, person-centered plan of care which contains clear directions to staff and others who are providing the person with direct care c) Explain the procedure and purpose of the TBI assessment to the person and/or their SDM/POA C, and obtain verbal or implied consent **Implementation** 1. Provide for privacy 2. Have or help the person remove any clothing that may restrict accurate assessment of their toe/leg pressures, i.e. shoes, socks, tight pants/shirts, sweaters, etc. 3. Have or assist the person to lie supine in a relaxed, comfortable position to facilitate the assessment – have them lie as flat as possible. Have/help the person position themselves so that their arms are at their side, palms up.

	NOTE: the person must remain in a supine position for at least 15 minutes prior to and during TBI testing to minimize any hydrostatic pressure inaccuracies 4. Ensure adequate lighting 5. Wash your hands 6. Don clean disposable gloves and expose the persons antecubital 7. spaces 8. Apply an appropriately sized blood pressure cuff on the person's RIGHT upper arm, approximately 1-2cm above the antecubital fossa **NOTE:** Cuff width must equal 20% more than the upper arm diameter or 40% of circumference around upper arm and two thirds of upper arm length. If the cuff is too narrow, the reading may be falsely high and vice versa 9. Palpate for the brachial pulse and place ultrasound gel (1/4" thick) over that area. **NOTE:** ensure there are no large air bubbles in the applied ultrasound gel, as the Doppler requires a continuous conducting medium 10. Turn the Doppler on and hold the 8MHz Doppler probe at a 45-60 degree angle to the artery (the probe itself should be pointing in the direction of the person's head) 11. Gently move the probe through the gel in a circular motion until you find the best quality pulse sound 12. Stabilize your hand/arm before inflating the blood pressure cuff to ensure that you are able to hold the probe in position as the cuff inflates/deflates 13. Inflate the blood pressure cuff quickly too approximately 70-90mmHg, and then further inflate in 20-30mmHg increments until the pulse sound is completely lost. Do NOT inflate the cuff past 200 mmHg this may dislodge any plaques that may be present in the blood vessels 14. Gradually deflate the cuff (2mm/sec) until the pulse sound returns, and record the pressure at which the pulse sound returns. **NOTE**: if it is necessary to re-inflate the cuff due to loss of sound, be sure to completely deflate the cuff before re-inflating. If the cuff is repeatedly inflated or left inflated for long periods, the systolic pressure reading may be falsely low. If the cuff is deflated too rapidly, the true systolic pressure may be missed 15. Repeat steps 7-13 on the LEFT arm.

	Next, proceed to performing the toe pressures 1. Ensure the foot is stable; movement of the sensor or wires can cause artifact to the PPG machine 2. Attach the toe pressure probe to the Doppler 3. Place the toe cuff on the base of the hallux (second toe if appropriate e.g. 1st toe amputation, ulceration of hallux) 4. Put PPG pad on the pad of the large toe slightly towards the second toe and not touching the cuffs and with the wire pointing down 5. Make sure the tape will hold the PPG in place but not compress the blood vessels by being too tight 6. Turn on the Doppler machine and you should see the patient's pulse as a waveform on the chart recorder 7. Connect he sphygmomanometer to the toe pressure cuff and inflate slowly until you see the waveform disappear 8. Not that this will take much less pressure at the toe than at the arm and may cause the patient discomfort 9. Slowly release the pressure in the cuff at about 2mmHg per second declination until the waveform reappears 10. Make note of the recorded pressure 11. Deflate the cuff completely 12. Repeat the toe pressure on the other foot **How to calculate the TBPI** Divide the highest toe pressure by the highest brachial pressure. The result is the TBPI. TBPI > 0.7 Normal indicating no arterial disease TBPI = 0.64 - 0.7 Borderline PAD TBPI < 0.64 - Abnormal indicating PAD 13. Remove remnants of the ultrasound gel from the person's skin 14. Assist the person to a comfortable position as needed and assist them with the reapplication of any clothing items removed for testing purposes, as needed. **NOTE**: the person may feel dizzy/lightheaded when they first sit up, so encourage them to remain seated for a few minutes before attempting to ambulate 15. If the person is to remain in bed, ensure the bed is returned to a safe height (if applicable), and ensure the person's safety, i.e. apply side rails, personal alarms, restraints, etc. as per the person's care plan/medical orders 16. Clean reusable equipment/surfaces touched during the procedure with warm soapy water or detergent wipes and dry thoroughly to

	prevent cross infection, returning reusable equipment to the appropriate places 17. Remove and dispose of your gloves in the appropriate receptacle and wash your hands 18. Calculate the person's left and right leg TBIs, and compare with any available previous results 19. Discuss the findings of the assessment with the person and/or their SDM/POA C and implement referrals and interventions indicated 20. Share the results of the Doppler testing with the interdisciplinary members of the person's wound care team 21. Complete/update and initiate the person's interdisciplinary person centered plan of care, based on your testing and overall holistic foot/lower leg assessment, as per your organization's policy **Evaluation** Unexpected outcomes: a. Doppler testing is not done according to this Procedure, and appropriate interventions are not initiated based on your holistic foot/lower leg assessment b. You are unable to complete the testing as the person is unable to lie flat for a period of 15 minutes pre-procedure and during the procedure, you are unable to detect pulses with the Doppler, or the application of an inflated blood pressure cuff is too painful for the person to tolerate Reassess ABIs: a. Every six months for people with 'healable' lower leg/foot ulcers b. Every six months for people undergoing compression therapy c. If the person develop signs of PAD d. If the person develops lower leg/foot pain unrelated to infection/injury
References	1. Hiatt WR, Goldstone J, Smith SC Jr., et al. Atherosclerotic peripheral vascular disease symposium II: Nomenclature for vascular disease. Circulation. 2008; 118:2826. 2. Dawson DL, Hiatt WR, Creager MD, et al. Peripheral arterial disease medical care and prevention of complications. Prev. Cardiol. 2002; 5:119-130. 3. Leng GC, Lee AJ, Fowkes FG, et al. Incidence, natural history and cardiovascular events in symptomatic peripheral arterial disease in the general population. Int J Epidemiol. 1996; 25:1172-1181. 4. European Stroke Organization, Tendera M, Aboyans V, et al. ESC Guidelines on the diagnosis and treatment of peripheral artery disease. Eur Heart J. 2011; 32:2851-2906.

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Related Tools (NOTE: these tools and their instructions can be found on the SWRWCP's website: swrwoundcareprogram.ca)	• Guideline: The Assessment of People with Leg Ulcers • Guideline: The Assessment of People with Diabetic/Neuropathic Foot Ulcers • Interdisciplinary Diabetic/Neuropathic Foot Assessment Form • Interdisciplinary Lower Leg Assessment Form