North West NHS Podiatry Services
Peripheral Arterial Disease Clinical Effectiveness Group

Guidelines for the Assessment and Management of Peripheral Arterial Disease

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Introduction

The Clinical Effectiveness Group for Peripheral Arterial Disease (PAD) consists of NHS clinical specialist podiatrists who share a particular interest in this field, and was initiated by the regional podiatry service leads to provide a forum for implementing best and evidence based practice, improving service delivery and continuing professional development.

The group was tasked with creating a guidance document to standardise the level of minimum and full recommended peripheral arterial assessment across the region provided within a Podiatry setting, to assist in the early detection of PAD, and aid in the prevention of outcomes such as cardiovascular events, ischaemic ulceration, gangrene and amputation. Although the document covers commonly presenting lower limb disease, including arterial, venous and lymphatic conditions presenting to Podiatrists, the focus is primarily on PAD, because of the prevalence (20% of the over 60s) and the significant associated limb, morbidity and mortality risks.

The purpose of the guidance document is to encourage clinicians and managers to review and redesign the peripheral vascular aspects of clinical services, based on best evidence, best practice service models and multidisciplinary agreement. The guidance can be used:

- To facilitate a 'definitive' early clinical diagnosis and guide appropriate urgent or non-urgent referrals, in order to improve the patients' prognosis for life and limb.

- To help prevent misdiagnosis by considering differential diagnostic criteria.

- To help provide appropriate key members of the healthcare team with relevant evidence-based information, in order to maximise clinically effective and cost effective treatment and ongoing management, via the GP and vascular team.

- To promote clinical audit / research with reference to evidence-based practice.

Minimum peripheral arterial assessment does not require specialist equipment or skills and should therefore be carried out by all podiatrists. It has been recognised regionally as a minimum clinical standard, to aid in the risk assessment of podiatry patients aged 50+ prior to podiatry treatment and at least annually thereafter.

If there are any significant clinical signs or symptoms of PAD at initial assessment, the patient should be referred for a **recommended peripheral arterial assessment** by an experienced / specialist clinician. This section of the document applies to those clinicians competent (or developing the competencies) to perform the key non-invasive diagnostic tests. This would usually be a specialist clinician within the podiatry team, or if not available, another healthcare professional with vascular assessment knowledge and skills.

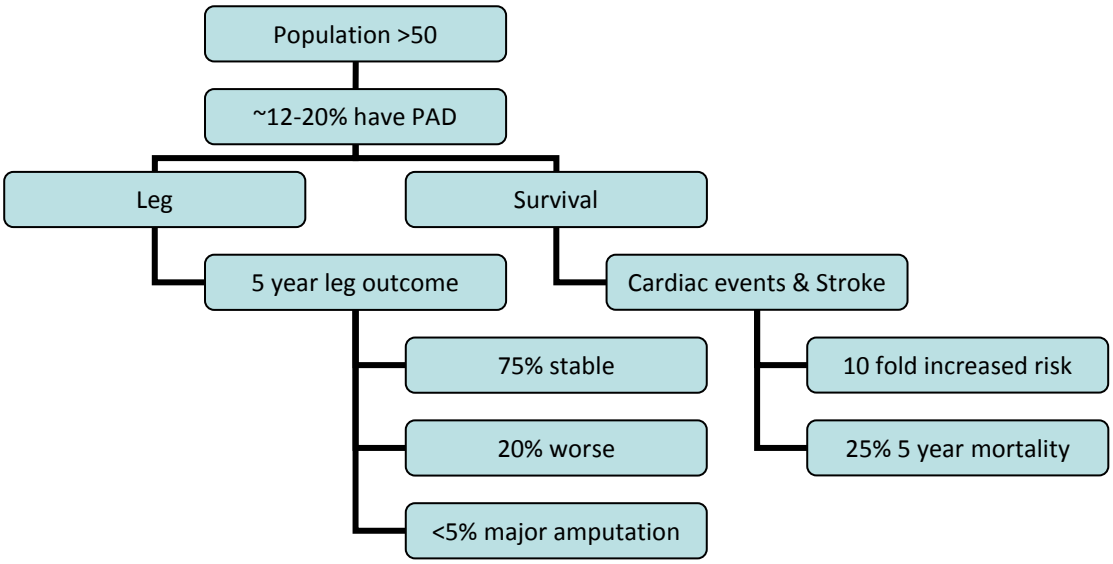
This is an ongoing document that has been subject to two regional reviews and endorsement nationally by the Society of Chiropodists and Podiatrists and Foot in Diabetes UK (FDUK). The latest review has aimed to simplify the guidance and link it primarily to the relevant NICE Guidelines and Quality Standards, as a source of best national clinical evidence. We hope all podiatrists who read it consider reviewing and updating their own practice and service pathways, to ensure a unified approach to early lower limb PAD detection and best treatment. Ultimately this will help to save more lives and limbs.

An overview of peripheral arterial disease

It is estimated that PAD affects around 20% of the UK population over the age of 60 (NICE, 2012). It is suggested to be under-diagnosed and undermanaged in many people, leading to potentially avoidable heart attacks, strokes and associated early deaths (Belch et al, 2007). In people with severe or critical arterial disease, amputation becomes another significant and modifiable risk. It may be asymptomatic or symptomatic - both associated with similar high mortality and cardiovascular event risks. (Diehm et al, 2009).

The ratio of symptomatic to asymptomatic disease is up to one in three with as many as 50% never consulting a doctor (Norgren et al, 2007). Those with PAD have a three-fold increase in risk of mortality from major cardiovascular events (heart attack and stroke) compared to those without PAD (Pande et al, 2011; Fowkes et al, 2008).

The natural history for people with PAD in a given population can be summarised as below:



(From: Timaran & Timaran, 2014)

Effective treatment strategies involve cardiovascular risk management including medicines, exercise, smoking cessation and in more severe cases revascularization - endovascular or open (Conte et al, 2015).

The NICE Guideline (CG 147) published in 2012 has provided a template for what individual clinicians and healthcare organisations should now provide for people with suspected PAD. The subsequent Quality Standard (QS52) published in 2014 has clarified what the absolute clinical implementation priorities are, to help identify and tackle this relatively common and devastating vascular disease.

Since NICE published this guideline, recognition and agreement has been reached between The College of Podiatry and the Vascular Society of Great Britain & Ireland, on a common approach to tackling PAD and that Podiatrists in particular are able to play a key role in both the early detection and best clinical management of PAD, working closely with colleagues, GPs and Vascular Teams (Fox et al, 2015).

NICE Quality Standard 52

The NICE Quality Standard for PAD (QS52) was published in 2014. The 5 Quality Statements in this publication summarise the priorities from CG147 to be implement, to ensure people with PAD get best diagnosis and treatment. The following NICE Quality Statements are considered to be the key priorities for clinicians to offer people with suspected and confirmed PAD.

Statement 1. People who have symptoms of, or who are at risk of developing, peripheral arterial disease (PAD) are offered a clinical assessment and ankle brachial pressure index (ABPI) measurement.
Statement 2. People with PAD are offered an assessment for cardiovascular comorbidities and modifiable risk factors.
Statement 3. People with intermittent claudication are offered a supervised exercise programme.
Statement 4. People with PAD being considered for revascularisation who need further imaging after a duplex ultrasound are offered magnetic resonance angiography (MRA).
Statement 5. People with intermittent claudication are offered angioplasty only when imaging has confirmed it is appropriate, after advice on the benefits of modifying risk factors has been given and after a supervised exercise programme has not improved symptoms.

These NICE PAD Quality Statements are relevant to all Health Professionals who assess and review people over the age of 50. The NICE PAD QS audit tool in Appendix 9 may be a good place to start, by 'bench-marking' what individual Podiatry Clinics or Services can demonstrate currently, in relation to people attending with suspected or confirmed PAD. Podiatrists working to the minimum or recommended PAD assessments outlined in this guideline will be able to demonstrate to a lesser or greater degree that they are aware of NICE and have reviewed their practice to help meet some of these standards, protecting patients and protecting themselves.

SECTION A – Minimum Peripheral Arterial Assessment

Prior to the treatment of any foot problems in adults, a minimum lower limb vascular assessment will guide clinicians to help identify any underlying peripheral vascular disease and identify those at need of a full non-invasive diagnostic vascular assessment, as recommended by NICE (NICE, 2012). A minimum vascular assessment should include:

1. **History of modifiable and non-modifiable risk factors**
2. **Palpation of foot pulses**
3. **Skin, temperature and other visible clinical features**
4. **Intermittent claudication and ischaemic rest pain**
5. **Differential diagnosis common leg symptoms**
6. **Identifying arterial ulceration and severity**
7. **History of venous disease**

Top tip - *Integrated Care Pathways for Peripheral Arterial Disease have been developed and implemented by Podiatry Services, working in partnership with Vascular Service, using the principles from these guidelines. They can be found in Appendix 8. They have been published and endorsed by NICE and could be implemented by all Podiatry and Vascular Services.*

A1 History of modifiable and non-modifiable risk factors

A detailed history needs to be elicited, with emphasis on modifiable and non-modifiable risk factors for PAD, which can indicate an increased risk of developing PAD or progression of the disease. Fowkes et al (2013) reviewed 14 risk factors for PAD and created a meta-odds ratio based on effect size for risk factors that were investigated by at least three studies using multi-variate analysis. The odds ratios, based on sample sizes varying from 25 000 to 60 000 in Europe, that significantly increased the risk of PAD are detailed in the table below. History of cardiovascular disease (regarded as a evidence of co-existing atherosclerotic disease and not a causal factor for PAD) was 2.55.

Risk Factors for PAD based on Meta-odds ratio (adapted from Fowkes et al, 2013)

	Risk Factor	*Odds ratio*	*Significant*
Non Modifiable	Age (per 10 year increase)	1.75	P<0.05
	Male sex	1.43	P<0.05
Modifiable	Hypertension	1.55	P<0.05
	Diabetes	1.88	P<0.05
	Current smoker	2.72	P<0.05
	Former smoker	2.03	P<0.05
	Hypercholesterolaemia	1.19	P<0.05
	Hypertriglyceridaemia	1.26	P<0.05
	C-reactive protein	1.82	P<0.05
	BMI (>25mg/m2)	0.96	Not significant
	Elevated LDL	1.03	Not significant
	Low HDL	0.90	Not significant
	Fibrinogen	1.07	Not significant

Race: Black ethnicity increases the risk of PAD by over two-fold in the US population. In the UK a study has shown prevalence of PAD to be similar with Black and South Asian people at around 12% (Bennett et al, 2009)

Other vascular history associated with PAD: Previous vascular surgery, erectile dysfunction, abdominal aortic aneurysm, reno-vascular connective tissue disorders, rheumatoid arthritis, vasospastic disorders and venous insufficiency can all be markers of risk factors for the development of PAD.

(Norgren et al, 2007)

Note: The group would recommend additional reading be advised on all the above factors to build further knowledge if required.

- **KEY RECOMMENDATION: Take a history of any significant risk factors as part of minimum peripheral arterial assessment**

A2 Palpation of foot pulses

The dorsalis pedis / anterior tibial and posterior tibial pulses should be palpated. Both pulses should be felt, however it is important to remember that the dorsalis pedis pulse may be congenitally absent in around 10-15% of people (Orchard & Strandness, 1993). Absent posterior tibial pulses are clinically significant, however clinical findings of absent peripheral pulses are more meaningful of occlusive disease in the context of clinical symptoms such as intermittent claudication (Palumbo & Melton, 1995). Peroneal pulses are usually easier to detect with Doppler than by palpation. They are usually located on the lateral lower leg, just above the lateral malleolus. It has been recommended they are routinely checked as part of a lower limb vascular assessment (NICE, 2012).

Palpation can be affected by room temperature (Mayfield et al, 1998). Anatomical variance is rare (Brearley et al, 1992). Some pulses may be non-palpable due to oedema. A referral for a recommended peripheral arterial assessment as described in Section B would be necessary. **In the event of suspected critical limb ischaemia the assessing clinician should instigate urgent referral to a Vascular Team. Early intervention by a Vascular MDT can help reduce lower limb amputation rates.**

See appendix 8 for PAD / CLI assessment and referral pathways that start with foot pulse palpation.

On palpation always classify the foot or leg pulse as palpable or non-palpable. If in doubt, classify as non-palpable and along with other clinical findings, consider the need for the next layer of vascular assessment. Palpation of foot pulses is subject to significant observer error and should be only used in combination with other objective measures as a guide to disease presence / absence and clinical management (Brearley et al, 1992).

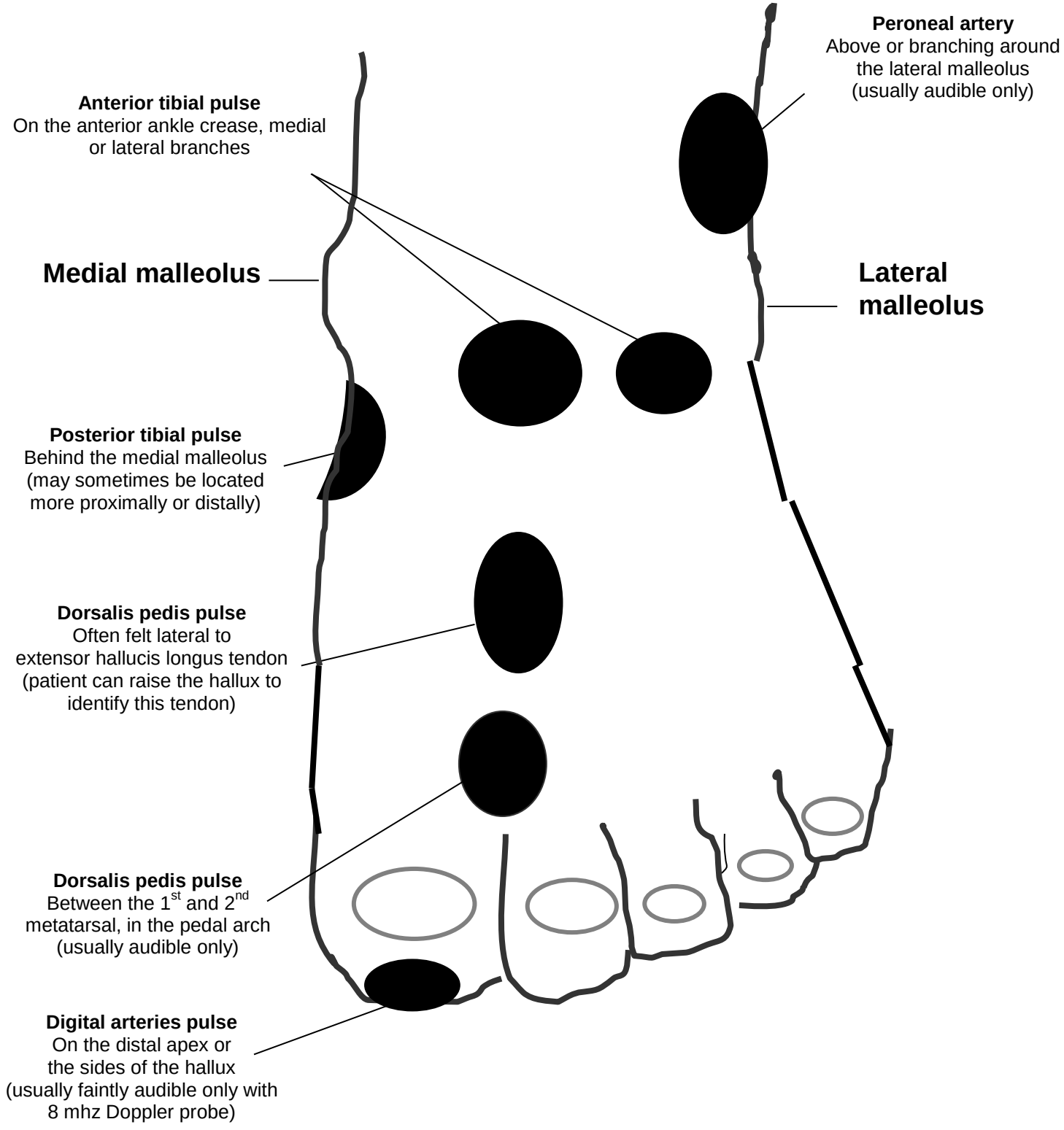
Top tip: *Asking the patient to relax their foot and leg muscles fully and then the examiner dorsiflexing the foot prior to palpating for dorsalis pedis and inverting the foot slightly prior to palpating for post tibial pulses can relax the soft tissues and help identify a palpable pulse. It is important to classify the pulse as non-palpable if the pulse is not easily felt and put this result in the context of other history and clinical findings.*

See Figure A for depiction of the common foot and ankle pulse points.

- **KEY RECOMMENDATION: Foot pulse palpation should be performed and results documented with all adults, prior to any podiatry intervention**
- **KEY RECOMMENDATION: Foot pulse palpation should only be used in combination with other objective measures to inform disease presence or absence and clinical management**

Figure A

Diagram to indicate the sites of the common palpable / audible foot pulses: posterior and anterior tibial and peroneal arteries



A3 Skin, temperature and other visible clinical features

Careful inspection of the limb and comparing features between the 2 limbs can provide useful information about the patient's circulation. Patients may have scars from previous vascular surgical procedures; their veins may have previously been used for cardiac or lower limb bypass or stripped as part of varicose vein surgery. Comparing the temperature of both limbs may give further clues to a patient's vascular status. A unilateral lower temperature may be an indication of PVD (Stoffers et al, 1997)

The temperature gradient of the skin is checked using the back of the hands and gently moving them from the pre-tibial region of the leg distally over the dorsum of the foot to the toes while keeping in contact with the patient's skin. An asymmetric gradient may indicate either unilateral ischaemia on the colder side or unilateral inflammatory response such as Charcot osteoarthropathy or infection on the warmer side (Edmonds et al, 2004). A skin temperature probe if available would give a more objective result on skin temperature variations.

Top tip: *Beware of patients with diabetes presenting with a warm reddened foot with no palpable foot pulses. They may have significant arterial insufficiency masked by the reactive vasodilatation of severe diabetic foot infection. Pain may be masked by neuropathy and even Doppler studies can be misleading due to calcification often present in their calf vessels. Please refer to Appendix 3 for further information on the use of Doppler.*

It is important to take into consideration the ambient temperature outdoors and of the room in which the assessment is being performed, and to keep the legs and feet covered for as long as possible before assessing foot temperature and pulses or this may result in misleading clinical signs.

Trophic changes occur secondary to tissue malnutrition from arterial compromise and include:

- hair loss
- thin, smooth, shiny skin
- thick brittle nails
- tapering of toes (Fahey, 1999)

Characteristics of the above, plus fissuring (especially of heels) and oedema could be indicative of ischaemia (Edmonds et al, 2004) and should be used as part of a full vascular assessment.

To determine capillary refill time the examiner applies firm pressure to the plantar aspect of the great toe for 5 seconds. If after releasing the toe it takes longer than 5 seconds for normal skin colour to return this is considered abnormal (Khan et al, 2006) but is of little diagnostic value. Capillary refill time although commonly used in clinical examination has not been shown to be reliable or valid (Nerida et al, 2007). A lack of clinical features must not preclude PAD especially in its early stages.

Assessment of skin colour and temperature should be taken into account as part of a full vascular assessment, but not solely relied upon for clinical diagnosis.

Colour may range from pallor/white appearance (which may be associated with acute ischaemia, severe anaemia, a vasospastic response or cold ambient temperature), to erythema (which may be associated with chronic ischaemia – dependent rubor, infection or a warm ambient temperature), or cyanosis (which may be associated with chronic

ischaemia, coronary/pulmonary disease, microcirculatory disturbances or cold ambient temperature).

Other vascular markers to be aware of include the vasospastic response found in primary Raynaud's Disease and secondary Raynaud's Syndrome, vasculitis or infarctions caused by rheumatoid arthritis, and varicose veins (Al'Khaffaf & Dorgon, 2005)

- **KEY RECOMMENDATION: The NICE Guidelines on PAD (2012) recommend that patients with a history or signs / symptoms suggestive of PAD should proceed to objective testing, including foot and leg pulse palpation and Doppler insonation of all lower limb pulses and an Ankle Brachial Pressure Index (ABPI).**

A4 Intermittent claudication and ischaemic rest pain

Intermittent claudication (IC) is defined as cramping muscle pain, commonly occurring in the calf, thigh, or buttocks, brought on by walking a predictable distance and relieved by rest. Relief should occur within 10 minutes and more commonly within 5 minutes (Norgren et al, 2007).

It is derived from the Latin 'to limp' (claudicare) and the pain may vary from a slight ache to severe cramp-like pain. Claudication, similar to angina, indicates inadequate arterial blood supply to contracting muscles.

IC is often the first and main symptom of peripheral arterial disease and an indicator of systemic atherosclerosis, however it does not always predict the presence or absence of PAD. In cases where neuropathy is present then symptoms of IC may be masked. In patients with limited mobility from other problems such as arthritis or COPD, or those who are sedentary, symptoms of IC may not be initiated as another condition may be masking them, even in cases of severe PAD (Norgren et al, 2007).

A diagnosis of IC can be made on the basis of the patient's history and the Edinburgh Claudication Questionnaire. The questionnaire is highly specific (91%) and sensitive (99%) for the condition (Leng & Fowkes, 1992). A copy of the Edinburgh Claudication Questionnaire is included in Appendix 1 and Appendix 7.

The distance walked by the patient before leg symptoms occur is termed the 'distance to onset'. This should be assessed and noted at each clinical review. Patients often walk for some distance further with their leg discomfort until either their claudication pain limits them or other limiting symptoms occur such as breathlessness, angina or back pain. This is termed the 'maximum walking distance'. The time taken for symptoms to resolve is termed 'resting time'. A prolonged resting time usually indicates a poorly developed collateral circulation whilst a rapid resting time suggests that well developed collaterals exist.

It is important to recognise whether the patient's claudication limits their ability to work, significantly impairs lifestyle or is deteriorating / stable.

Pain in the legs brought on by exercise is a common complaint and not always due to arterial occlusive disease. There are other medical conditions that can mimic claudication (See section A5 – Differential Diagnosis). ABPI and further investigative tests should be used to confirm a clinical diagnosis of PAD.

- **KEY RECOMMENDATION: All people presenting with symptoms of intermittent claudication should be referred for further non-invasive vascular assessment and management.**

Ischaemic rest pain occurs with advanced arterial occlusive disease, when resting blood flow is insufficient to meet the maintenance metabolic requirements for non-exercising tissue (Dormandy et al, 1999). The pain typically occurs at night and interferes with a patients sleep, but in severe cases can be continuous. It is described as unremitting pain typically in the distal part of the foot or in the vicinity of an ischaemic ulcer or gangrenous toe that is aggravated by elevation and diminished by hanging the foot in a dependent position. It has usually been present for > 2 weeks, with no relief from usual analgesia Norgren et al, 2007). It can indicate critical limb ischaemia (CLI).

- **KEY RECOMMENDATION: All people presenting with ischaemic rest pain and suspected CLI should be referred urgently to the Vascular Team.**

Top tip: *Nocturnal calf cramps is quite common and is not ischaemic rest pain. If you suspect ischaemic rest pain in the foot or toes, check foot pulses again. They are usually all non-palpable in that foot and leg, pulses signals are monophasic or not audible with Doppler and ankle systolic pressures if checked will usually be low (< 50mmHg or < 70mmHg with ulcer present).*

A5 Differential diagnosis of common leg symptoms

It is important to consider a differential diagnosis for any patient presenting with pain in the legs, in order to appropriately identify patients who are displaying symptoms of IC. There are a number of other conditions that can imitate claudication, including nerve root compression, spinal stenosis, hip arthritis or chronic compartment syndrome. It is not uncommon for patients to present with symptoms of PAD as well as nerve root compression or arthritis. Establishing which underlying condition is the most limiting factor for the patient can be quite complex and may require specialist vascular input. Surgery on the knee joint, for example, is extremely hazardous in patients with significant arterial disease in the affected leg.

- **A table is included in Appendix 2 to aid differential diagnosis.**

- **The Edinburgh Claudication Questionnaire is a useful tool to help identify intermittent claudication. See Appendix 1.**

A6 Identifying arterial ulceration and severity

Arterial or ischaemic ulceration typically occurs over the toes, heels and bony prominences of the foot, often originating from minor trauma, for example ill-fitting footwear. Gangrene may occur, particularly of the digits, and if not complicated by infection can eventually mummify and auto-amputate (Norgren et al, 2007).

An ischaemic or gangrenous toe may be present in a small number of patients despite strong foot pulses. These patients may have an aortic or popliteal aneurysm that results in thrombus formation locally and the first sign can be an embolus that breaks away and lodges in a distal digital or forefoot artery. Gangrenous or blue ischaemic toes may not be painful in diabetic patients with significant peripheral neuropathy. Lack of protective sensation in the foot is usually ascertained initially by testing with 10g monofilament (NICE, 2015).

Patients with arterial ulcers will typically display absent pulses, a cold and often hairless foot, which is pale or cyanotic, with associated pain from the ulcer (Edmonds et al, 2004).

- **KEY RECOMMENDATION: All people with diabetes and foot ulceration should be referred to the Diabetes MDT for consideration of further vascular assessment and opinion.**

- **KEY RECOMMENDATION: All people with peripheral arterial disease and foot or leg ulcers should be referred to the Vascular Team for further opinion.**

A7 History of venous disease

It is good practice to ascertain if the patient has a history of varicose veins, deep vein thrombosis (DVT) or varicose vein surgery, to add to the clinical picture. A common cause of leg ulceration is venous disease, for example in the post-thombotic limb. Please see Section E for further information on the venous system. People with symptomatic venous disease should be considered for referral to a Vascular Team for Duplex assessment and further vascular opinion, following consideration from their GP and in line with local commissioning (NICE, 2013).

SECTION B – Recommended Peripheral Arterial Assessment

Following the minimum assessment as detailed in Section A, further recommended peripheral arterial assessment will be necessary prior to any lower limb or Podiatry treatment, if peripheral arterial disease is suspected (NICE, 2012)

Ensure recommended peripheral arterial assessment if:

- **No pulses are palpable on one or both feet**
- **There are symptoms of intermittent claudication or ischaemic rest pain**
- **Foot pulse signals are monophasic with handheld Doppler**
- **There is a presentation of ischaemic or non-healing foot ulceration**

The recommended PAD assessment should be carried out by an experienced / specialist clinician with competencies in lower limb vascular assessment. Ideally they will work closely with or have direct referral links to the local Vascular Team, have demonstrated and documented competencies in lower limb vascular assessment and have evidence of continued professional development specific to this area. The results of a full non-invasive vascular assessment will determine the future clinical diagnosis and management plan including liaising with the patients' GP or a Vascular Consultant.

The recommended PAD assessment tests focused on in this document are:

1. **Handheld Doppler assessment**
2. **Ankle brachial pressure index (ABPI) and ankle systolic pressure**
3. **Toe systolic pressures**
4. **Assessment of popliteal and femoral pulses**
5. **Other clinical tests (Buergers)**

B1 Handheld Doppler assessment

The hand-held Doppler probe is now widely used as a screening tool to assess peripheral arterial circulation (Vowden et al, 1999).

Evaluation of the patients' arterial blood flow should be made using the hand held Doppler by a clinician who has the competency to locate the foot and leg pulses and interpret the results.

- **Refer to appendix 3 for Doppler technique and clinical explanation and evaluation of Doppler sounds and waveforms.**

B2 Ankle brachial pressure index (ABPI) and ankle systolic pressure

The measuring of the pressure in the ankle arteries has become a standard part of evaluation of patients with suspected PAD, recommended by NICE (2012) and major international vascular guidelines (Norgren et al, 2007) The comparison of the systolic pressure measured at the ankle with that of the brachial artery is a good indicator of the presence and severity of the disease, when used with other clinical factors at assessment.

A reduced ABPI is also a predictor of the risk of future cardiovascular events, the lower the ABPI predicting the higher the risk, independent of other risk factors. There is no strict definition of what constitutes a normal ABPI, however the consensus is in practice an ABPI <0.90 is considered abnormal which would be the typical cut-off point for diagnosing PAD (Norgren et al, 2007) A meta-analysis of 15 population studies showed that ABPI < 0.90 was strongly correlated with all-cause mortality (Fowkes et al, 2005) The procedure for performing an ABPI is detailed in Appendix 4.

- **KEY RECOMMENDATION: All people with suspected PAD should be assessed with foot pulse palpation, Doppler insonation and ABPI initially**

B2.1 Cautions with ABPI

The measurement of ABPIs is non-invasive, safe and well tolerated in most circumstances. It should however be discontinued if it becomes painful during inflation of cuffs and avoided over recently placed distal bypass grafts due to the potential risk of causing graft thrombosis. If used in the presence of ulcers, the ulcer should be covered first and infection control procedures flowed to minimize cross infection (Aboyans et al, 2012). Other situations where cuff inflation is not appropriate in one or more limbs are:

- Recent history of deep vein thrombosis - past 3 months
- Severe cellulitis / ulceration that would make application of the cuff inappropriate
- Active vasculitis i.e. in patients with rheumatic disease or connective tissue disorders
- Patient intolerance as a result of severe calf pain
- History of breast cancer with lymph node involvement (arm)
- Over an AV fistula or midline PICC line (arm)

B2.2 Calculations

A separate result is achieved for each leg using the following division:

$$\frac{\mathbf{A}}{\mathbf{B}} \quad \text{i.e.} \quad \frac{\text{Highest } \mathbf{A}\text{nkle systolic pressure (per leg)}}{\text{Highest } \mathbf{B}\text{rachial systolic pressure from arms}}$$

e.g. $\frac{90}{150}$ = ABPI 0.6 $\frac{145}{135}$ = ABPI 1.07

B2.3 Interpretations

Ankle Brachial Ischaemic Index	Indication
0.90 –1.30	Normal
<0.90	Abnormal (with or without symptoms)
<0.40	Severe / Critical Limb Ischaemia
>1.30	Vascular calcification

The above interpretations are recommendations of the North West Podiatry Services Clinical Effectiveness Group, and are based on evidence based clinical consensus guidelines and local expert opinions (NICE, 2012; Norgren et al, 2007)

Patients with symptoms of IC typically have an ABPI of 0.5 – 0.9, and ischaemic rest pain most commonly occurs below 0.4.

Interpretations may vary slightly between health organisations based on the protocols, guidelines and referral criteria of the vascular surgeons in your area.

- **KEY RECOMMENDATION: ABPI must be carried out by clinicians who have been trained and who perform this test regularly. This will help ensure accurate results and interpretation.**

- **Integrated Care Pathways for peripheral arterial disease and critical limb ischaemia, which have been developed and implemented by multi-disciplinary clinicians and managers using the principles in these guidelines, can be found in Appendix 8.**

B2.4 Calcification of leg or foot arteries

Calcified arteries in ischaemic feet may give false readings within the normal ranges. It is therefore important that signs and symptoms are taken into consideration at assessment.

In some patients with Diabetes, renal insufficiency or other diseases that cause vascular calcification the tibial vessels at the ankle become non-compressible, leading to false elevation of the ankle pressures. These patients typically have an ABPI >1.3 or > 1.4 (Aboyans et al, 2012). If the ankle arteries are non-compressible due to calcification then Doppler waveform signals, toe pressures and / or vascular ultrasound imaging should be considered as part of further vascular assessment (Brownrigg et al, 2015).
Calcification of leg arteries is important to identify, as it links to increased cardiovascular risks and if in conjunction with occlusive arterial disease, limb risk (Aboyens et al, 2012). Performing an ABPI can help identify people with calcification of leg arteries and along with other clinical assessment, can help guide cardiovascular and limb risk management.

B2.5 Ankle systolic pressures

Performing an ankle systolic pressure can be useful when guiding clinical decisions, particularly in people with suspected severe or critical limb ischaemia. Similar to ABPI, it is a relatively safe, non-invasive assessment and as it may only involve taking a systolic pressure from the limb of concern, can be done much quicker than an ABPI. The identification of an ankle systolic pressure < 50 mmHg, indicates a likely critical limb ischaemia and is associated with a higher risk of limb amputation (Aboyans et al, 2012).

B2.6 Post-exercise ankle systolic pressures

Patients with symptoms of claudication who have a resting ABPI result within normal range guidelines may need a post-exercise ABPI assessment to differentiate between ischaemia and a spinal canal stenosis. The ABPI result when repeated post-exercise on a person with peripheral arterial stenosis will usually fall, whereas with lumber canal stenosis it will remain the same (Grasty, 1999)

B2.5 Common errors during ABPI assessment

Errors may arise if:

- The clinician ‘slips off’ the Doppler waveform signal with the probe during sphyg cuff inflation, which can produce a false low systolic ankle pressure result.
- The pulse is irregular or the cuff is deflated too rapidly, missing the true systolic ankle pressure.
- The vessels are calcified and this is not taken into account with other indicators such as clinical signs / symptoms or monophasic Doppler signals
- The legs are large or oedematous
- The cuff size is inappropriate e.g. small cuff used on a large limb
- The legs are raised too high or too low, or the patient is not lying flat for 10 minutes before readings are taken

B3 Toe systolic pressures

As toe arteries are less likely to be calcified taking toe systolic pressures may be helpful for patients with a falsely elevated ABPI measurement, if the clinician has the skills, experience and the equipment to do it (Norgren et al, 2007). However, digital calcification should not be ruled out, particularly if seen on previous X rays or if the toe systolic pressure is suspiciously high (Brooks et al, 2001).

Toe systolic pressures have been shown to be directly related to the outcome of foot ulceration healing (Brownrigg et al, 2015). Toe systolic pressure is normally approximately 30mmHg less than the ankle systolic pressure, and an abnormal toe brachial pressure index is < 0.70. Toe systolic toe pressures and toe brachial pressure index (TBPI) are useful in clinical decision-making. Taking into account local expert and review group opinion, we will focus in these guidelines purely on toe systolic pressures, rather than TBPI.

A toe systolic pressure < 50mmHg would suggest an ischaemic component to any foot ulcer. If toes systolic pressures are < 30mmHg, this would suggest critical limb ischaemia (Norgren et al, 2007). Once again, it is recommended a clinical specialist who has competence in performing and interpreting the results of the test undertake this investigation.

- **KEY RECOMENDATION: In people with known or suspected leg artery calcification, consider further assessing further using toe systolic pressures to help with clinical decision making**

- **KEY RECOMMENDATION: In people presenting to a Multi-Disciplinary (Foot) Team with foot ulceration, consider taking toe systolic pressures as part of further assessment to help identify the severity of ischaemia and potential for ulcer healing in the foot**

B4 Assessment of popliteal & femoral pulses

Non-invasive lower limb vascular assessment also includes assessment of popliteal and femoral pulses (NICE, 2012). This can be done by palpation and use of 5 mhz Doppler probe to identify whether each pulse is palpable and what the Doppler waveform signal is. This can help provide guidance on presence, severity and anatomical location of any PAD in each limb, which in turn can help guide the clinician on whether to proceed with a best medical therapy or surgical opinion approach (Fox el at, 2012).

In addition, opportunistically checking the abdominal aorta for any excessive and expansile pulsation is performed as standard in most vascular out-patient clinics and can help identify undiagnosed abdominal aortic aneurysms. With local Consultant Vascular Surgeon support, Vascular Specialist Podiatrists and Nurses can be shown how to do this quick clinical check as part of the full PAD assessment. This has been shown to identify people with undiagnosed abdominal aortic aneurysms, which if they rupture, result in very high mortality rates (Fox et al, 2014).

B5 Other clinical tests

Buergers Elevation Test

This brief clinical test may add some useful information to the clinician, when assessing for presence of severe PAD.

The Buergers test can be useful in cases where vascular calcification is suspected due to abnormally high ankle pressures. The limb should be elevated, with the knee straight, to 45 degrees for one minute until dorsal veins empty. The limb is then slowly lowered.
Normal colour should be restored in less than 10-15 seconds. 20-40 seconds indicates moderate to severe ischaemia. If the colour on dependency becomes a dusky pink hyperaemia, this can indicate severe ischaemia and is termed a positive Buergers test (Norgren et al, 2007). It is not a highly accurate diagnostic test, but may help with clinical decision-making along with other history and clinical indicators.

- **KEY RECOMMENDATION: If severe PAD or CLI is suspected, but cannot be confirmed by initial lower limb arterial assessment, refer on to the Vascular Team for further opinion and assessment, stating your suspicion.**

SECTION C – Critical and Acute Limb Ischaemia & Blue Toe

C1 Critical limb ischaemia

Critical limb ischaemia (CLI) is a manifestation of PAD that describes patients with chronic ischaemic rest pain, or patients with ischaemic skin lesions, either ulcers or gangrene. The term should be used with reference to patients with symptoms of rest pain for more than 2 weeks requiring regular analgesia, ischaemic ulceration or gangrene, and ankle systolic pressures less than 50mmHg (70mmHg if ulcers present) or toe systolic pressures less than 30mmHg (Norgren et al, 2007).
There is estimated to be approximately 500 – 1000 new cases of critical limb ischaemia every year per European / North American population of 1 million (Norgren et al, 2007).

- **These patients need an urgent referral to a vascular team. Delays in referral may compromise the chances of successful surgical or endovascular revascularization.**

- **Integrated Care Pathways for Peripheral Arterial Disease, including suspected critical limb ischaemia, which have been developed and implemented by multi disciplinary clinicians and managers using the principles from these guidelines, can be found in Appendix 8.**

- **The StAMP Pathway for Critical limb Ischaemia has been developed regionally in partnership with NHS England and can be found in Appendix 8.**

C2 Acute limb ischaemia

Acute limb ischaemia (ALI) indicates a quickly developing or sudden reduction in limb perfusion, usually producing new or worsening symptoms and signs, and often threatening limb viability.

This may present as the rapid progression of PAD from IC to rest pain, to ischemic ulcers or gangrene. It can also occur as the result of a thrombosis or embolic event or the occlusion of a previous vascular intervention e.g. blocked bypass graft.

Observations of ALI may include the following:

- Pain: Onset, intensity and location, variance over time

- Pulseless: Non-palpation of pedal pulses is suggestive but not diagnostic of acute limb ischaemia. Ankle blood pressure index should be performed as typically a very low pressure is obtained or the Doppler signal is absent

- Pallor: Most important when differs from contra-lateral limb

- Parasthesia: Occurs in more than half of patients

- Paralysis: This is a poor prognostic sign in combination with other indicators

- Perishing cold: The limb is receiving little / no oxygenated blood

The Inter-Society Consensus for the Management of PAD (Norgren et al, 2007) detail the above, and recommend that all patients with sudden onset, suspected ALI should be evaluated immediately by a Vascular Specialist as the limb is in immediate danger of gangrene and amputation (within 6 hours).

- **KEY RECOMMENDATION: All people with suspected acute limb ischaemia must be referred <u>immediately</u> to a Hospital Vascular Unit as a medical emergency, as the limb can become necrotic within hours.**

C3 Blue Toe Syndrome

Blue toe syndrome is characterized by a sudden onset of an often painful blue, purple, red or black toe. The most common reason is local tissue ischaemia, secondary to atheroembolic disease or arterial aneurysm, further 'upstream' in the arterial system. It is usually distinct from vasospastic disorders such as Raynauds Syndrome, where multiple digits on both feet and often the hands are affected, with a more diffuse clinical presentation (Poredos, 2004).

Differential diagnosis includes:

- Emboli from cardiac and arterial system
- Acquired hypercoagulability disorders
- Syndromes resulting in peripheral vascular pathology

Blue toe syndrome is often misdiagnosed on initial presentation with palpable foot pulses leading the clinician away from suspicion of a vascular pathology. The most important action is to refer on urgently for pain management (via GP) and further vascular opinion and investigation.

SECTION D: Management of PAD risk factors and intermittent claudication

All health professionals involved in the care of patients diagnosed with PAD should be aware that many of the risk factors for this disease are modifiable, and can be treated and managed appropriately at any stage of disease progression from early onset to severe or critical limb ischaemia:

Smoking cessation is a factor that must be addressed. Smoking increases cardiovascular mortality by accelerating atherosclerosis and enhancing the effects of other risk factors such as diet, hyperlipidaemia and hypertension. Various treatment therapies are available, over the counter and via GP's surgeries. Nicotine replacement therapy has been shown to positively influence patients motivated to stop smoking.
In a Public Health England evidence review, electronic cigarettes are considered with best estimates to be 95% safer than continued smoking of tobacco. The report recommends that: Clinicians could inform people who are still smoking tobacco of this and encourage them to consider switching, if they are failing to quit smoking tobacco by other means (McNeil et al, 2015)

Supervised exercise regimes are beneficial and effective for patients with intermittent claudication, to help improve claudication symptoms and walking distances. This is recommended as the first line treatment for people with intermittent claudication (NICE, 2012). Supervised exercise programmes are available in some areas via Physiotherapy, Exercise Therapist and Cardiac Rehabilitation services. Salford Royal Foundation Trust has been the first NW regional NHS Trust to commission access to their existing Cardiac Rehabilitation programme for people with intermittent claudication, proving both cardiovascular risk reducing interventions and supervised exercise (Matthews et al, 2016).

Best medical therapy of antiplatelet and lipid lowering drugs should be commenced and reviewed periodically for all people diagnosed with PAD, as should the effective control of hypertension (NICE, 2012).

Weight management can be beneficial in people with arterial disease who present with hyperlipidaemia, hypertension and obesity. Weight reduction and good diet are a key part of a cardiovascular risk management strategy. Weight loss classes can be helpful in providing ongoing support to those trying to lose weight (NICE, 2012).

Naftidrofuryl is the only medicines currently recommended by NICE which is effective in some people to help with the management of intermittent claudication. It can be considered with people who have not been able to improve symptoms with exercise and prefer not to or are not appropriate for vascular surgery (NICE, 2012).

- **KEY RECOMMENDATION: All people with confirmed PAD should have modifiable cardiovascular risks explained, addressed and reviewed at every opportunity with Health Professionals**

- **KEY RECOMMENDATION: All people with confirmed PAD should have appropriate cardiovascular risk reducing medicines prescribed and reviewed periodically, to help optimally reduce vascular risks**

SECTION E : Venous and Lymphatic System

Poor venous and/or poor lymphatic drainage lead to an accumulation of waste products in the tissues causing oedema – this has an adverse effect on tissue viability. Foot and ankle oedema may occasionally be the first presenting symptom of systemic disease (NICE, 2013). Oedema will cause increased footwear pressure and may lead to further problems. If this is a long-standing problem assessment for specialist footwear may be appropriate.

A unilateral presentation of leg or foot oedema suggests a peripheral cause e.g. deep vein thrombosis, whereas a symmetrical presentation is more likely to be systemic e.g. congestive heart failure, renal failure or low protein levels in blood.

E1 Signs of venous or lymphatic insufficiency

Oedema – oedema of the legs and feet can be pitting or non-pitting

Varicose veins – these are dilated, tortuous veins that bulge unevenly to give a knotted appearance. An aching sensation associated with ankle oedema may suggest a problem with venous drainage and varicosities may be more apparent upon standing

Telangiectasia – the appearance of tiny thread veins usually around the medial malleolus

Haemosiderin staining – brownish skin pigmentation following the course of superficial veins

Atrophie blanche – white patches on the skin around the ankles due to fibrosis & sclerosis of the tissues caused by strangled microcirculation

Lipodermatosclerosis – induration caused by fibrosis of subcutaneous fat

Varicose eczema – discoloured, scaly, lichenified skin in the presence of oedema – this condition may be very itchy and may lead to the development of ulcers

Cellulitis – infection which may cause legs to become painful, hot and red

Phlebitis – inflammation of veins, causing mild pain and soreness when pressure is applied over the involved vein

Evidence or history of previous venous ulceration is a risk factor for reulceration

(NICE, 2013; Bergan et al, 2006)

E2 Deep vein thrombosis

Deep vein thrombosis (DVT) occurs most commonly in the calf veins and frequently follows surgery, bed rest or periods of immobility. Taking a medical history may reveal pointers such as a recent long haul flight, an oral contraceptive pill containing oestrogen or a family history of DVT. It usually presents as swelling and pain in the calf or lower limb, though many patients have few or no symptoms and are diagnosed when pulmonary embolism occurs.

(NICE, 2013)

Differential diagnosis includes superficial thrombophlebitis, muscle tears, ruptured Tendo–Achilles, Baker's cyst and fracture (Vowden et al, 1999). DVT carries a high morbidity and mortality rate, and so any suspected DVT should be treated as a clinical emergency with patients being directed to DVT out-patient services or Accident and Emergency for DVT assessment, after discussing with their GP if possible.

The Wells DVT score is a quick guidance tool that can be used to assess likelihood and guide further action, by any clinician who suspects their patient may have a DVT. See Appendix 6.

- **KEY RECOMMENDATION: All people presenting with a suspected undiagnosed DVT and a Wells Score of 2 or more should be referred for further assessment**

E3 Signs of poor lymphatic drainage - lymphoedema

Lymphoedema may be classed as primary or secondary. This can be distinguished from venous insufficiency related oedema by the lack of varicose veins.

Primary lymphoedema: Is often hereditary and can be unilateral or bilateral, with a frequently slow onset. It begins as a soft pitting form but becomes harder and non-pitting with time.

Secondary lymphoedema: Arises as a result of trauma to the lymph system such as damage due to injury, surgery, malignant disease, infection or radiotherapy.

It is usually unilateral and considerable fibrosis can occur. Lymphoedema is frequently complicated by infection causing the limb to become red, hot and painful.

Pitting / non-pitting oedema: The common clinical test is for digital pressure to be firmly applied to the affected area for a period of 3-5 seconds. If an imprint remains, the oedema is described as pitting.

If the area cannot be depressed this indicates non-pitting oedema which is a chronic condition caused by fibrosis of the tissues (McLeod-Roberts, 1996)

Clinicians are advised to liaise with the patient's GP initially for further opinion and management of these conditions.

SECTION F: Audit and Research

There are various national and international clinical guidelines available to assist clinicians, managers and commissioners to deliver quality clinical services for people with peripheral arterial disease.

More recently the NICE Guideline on PAD (2012) and the subsequent NICE Quality Standards (2014) provide clinicians and their clinics and NHS organisations with recommendations and standards that all patients should reasonably expect to receive. They also contain research recommendations that will guide clinicians and researchers who are looking to prioritise research activity and are more likely to attract funding to support it.

An example of benchmarking or audit tool that can be used by clinicians and clinical services to measure themselves against is provided in Appendix 9. Further information on how to facilitate the use of this tool for peer / clinical service review can be obtained from the 2017 Review Group.

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Appendix 1

Edinburgh Claudication Questionnaire

Please ask the patient the following questions:

a) Do you get pain or discomfort in your leg(s) when you walk?

Yes □ **No** □

If you answered "Yes" to question (a) – please answer the following questions. If you answered 'No' you need not continue.

b) Does this pain ever begin when you are standing still / sitting?

Yes □ **No** □

c) Do you get this pain if you walk uphill or when you hurry?

Yes □ **No** □

d) Do you get this pain when you walk at an ordinary pace on the level?

Yes □ **No** □

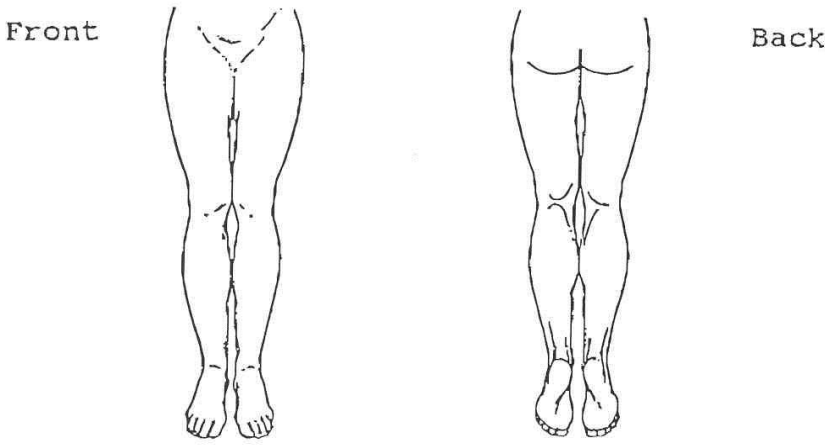
e) What happens to this pain if you rest?

Usually continues for more than 10 minutes **Yes** □ **No** □

Usually disappears in 10 minutes or less **Yes** □ **No** □

Where do you get this pain or discomfort?

Mark the place(s) with " x " on the diagram below



Note (for Physician use Only)

Definition of positive claudication - requires all of the following response:
Yes to 'a'
No to 'b'
Yes to 'c'
No to 'd' = grade 1 or Yes to 'd' = grade 2
Usually disappears in 10 minutes or less to 'e'
If these criteria are fulfilled, a definite claudicant is one who indicates pain in the calf, regardless or whether pain is also marked in other sites; a diagnosis of atypical claudication is made if pain is indicated in the thigh or buttock, in the absence of any calf pain.

Appendix 2

Questions for patient: "Do you get pain/discomfort in your legs?"	Differential Diagnosis Table (Leg Pain)				
	Circulation Pain			Nerve Pain	
	Intermittent Claudication	**Rest Pain**	**Non-ischaemic night cramps**	**Painful Neuropathy**	**Spinal Stenosis**
What does it feel like?	Ache Tightening Cramp-like	Severe pain / cramp / ache Un-remitting	Ache Cramp	Burning Tingling Pins & Needles	Weakness Sharp pain
Where do you feel it?	Calf Thigh Buttock	Lower leg Esp. feet	Calf Thigh	Entire leg / below knee	Hip Thigh Buttocks Calf
What brings it on?	Walking/Exercise	Constant Unable to sleep	At rest Sudden movement	May come and go	Exercise / standing for a long time
What makes it worse?	Inclines Walking faster	Constant Leg Elevation	Sudden movement	Lying in bed Worse at night	Exercise / standing for a long time
What eases the pain?	Rest	Strong painkillers Hanging leg out of bed Standing up	Rubbing leg Walking around	Standing Walking around	Lumbar Spine flexion
Other Characteristics	Reproducible	Absent pulses Visible atrophy History of PVD	Can be helped with Quinine	Diabetes Alcohol Dependency Vitamin B deficiency	Frequent / history of back problems

Appendix 3

Doppler technique and interpretation of waveforms

Equipment Needed

- Doppler unit with 8 Mhz and 5Mhz probe. 5Mhz will be required for grossly oedematous limbs.
- Ultrasound gel
- Ear phones (if preferred, or for noisy clinics)

Method

1. Apply a liberal amount of gel around the area where you would expect to locate the pulse. See Figure A Page 9 for the usual foot and ankle pulse sites. The gel should be as free from air as possible. An ultrasonic gel should be used, as KY jelly is not a suitable medium.

2. Earphones can be useful when evaluating the phasic quality of the pulses as the flow in different directions is heard in stereo. The signal is amplified and the earphones limit the interference from outside sounds. This is helpful in a noisy clinic.

3. Gently place the probe at an angle of between 45-60 degrees on to the skin surface with the probe pointing against blood flow (due to anatomical variation this direction may not be obvious). If the probe is applied with too much pressure, this may affect the flow and/or occlude the vessel and the signal will disappear.

4. Sweep the probe across the surface of the skin until the clearest pulsatile signal is obtained.

Remember that veins are located next to arteries. A venous signal can be likened to the sound of a continuous howling gale, therefore reposition the Doppler probe to locate the adjacent artery.

Interpretation

Arterial sounds/signals
In the lower limb, the normal Doppler waveform signal detected from arterial flow has three phases and in therefore described as **triphasic**. With an audible Doppler this results in 3 distinct sounds and with a visual waveform device, 3 distinct peaks on the graph.

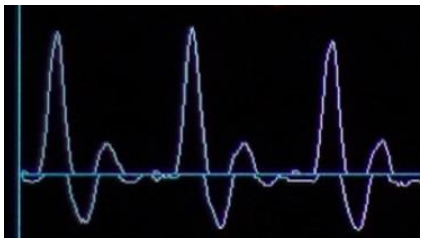
Phase 1: When the heart contracts, blood accelerates in a forward direction within the vessel. This is the loudest noise.

Phase 2: A drop in pressure from peak systole leads to reverse flow within the vessel

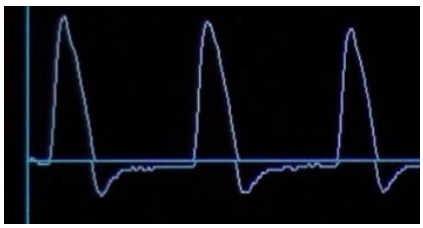
Phase 3: Elastic recoil of the vessel at the end stage of diastole leads to a further forward flow component.

Appendix 3 - cont

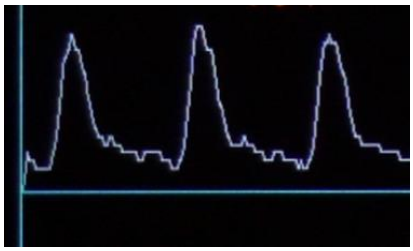
Triphasic signal
This indicates that the vessels are healthy. As a guide it can be useful to listen to your own radial artery.

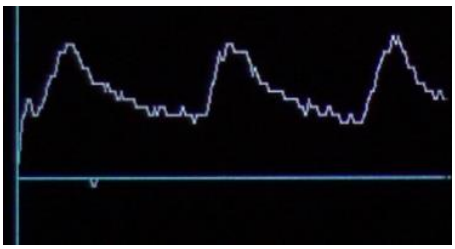


Biphasic signal
Reduction in the reverse flow and loss of the third phase is considered a normal part of the aging process but may indicate a proximal stenosis, so may warrant further assessment if the patient is symptomatic.



Monophasic signal
Indicates the presence of diseased arteries. In cases of complete proximal occlusion and collateral circulation blood flow is monophasic and continuous over the cardiac cycle, often producing an audio signal which can be described as “howling” not to be not be confused with venous flow.





NB Although the loss of reverse flow phase is normally an indication of the severity of arterial disease, some patients will show no reverse flow due to recent exercise or high ambient temperature, producing vasodilated distal circulation.

Rigid vessels – Calcification
In this situation, the sound generated has been likened to that of ‘soldiers marching’ although quite often it is not possible to detect any obvious pathology until an ABPI is attempted and Doppler pulse sounds cannot be stopped by the time the cuff is inflated to around 220mmHg or more. It is important not to apply excessively high pressures (250mmHg+), as it may cause skin damage and severe pain.

With vessel wall calcification, the lumen of the artery may be either stenosed or non-stenosed. The Doppler signal and audible phases (mono / bi / tri) can help establish presence of occlusive disease proximal to femoral, popliteal and foot pulses.

The interpretation of Doppler signals and waveforms should be performed by a clinician with the knowledge, skills and competence to do so.

Appendix 4

Performing an Ankle Brachial Pressure Index assessment

Equipment needed

- Doppler unit with 8Mhz probe
- Ultrasound gel
- Sphygmomanometer with a suitable size of cuff for the patient being assessed.
- Calculator

Method

1. The patient should be at rest 5 to 10 min in the supine position, relaxed, head and heels supported, in a room with comfortable temperature (19°C–22°C/66°F–72°F).
2. The patient should not smoke at least 2 hours before the ABI measurement.
3. The cuff should be chosen adequately according to the limb size. The width should contour at least 40% of the limb circumference.
4. The cuff should not be applied over a distal bypass (risk of thrombosis) or over ulcers. Any open lesion posing potential contamination should be covered with an impermeable dressing.
5. The patient should stay still during the pressure measurement. If the patient is unable to not move his/her limbs (eg, tremor), other methods should be considered.
6. Similar to the brachial blood pressure measurement, the cuff should be placed around the ankle using the straight wrapping method. The lower edge of the cuff should be 2 cm above the superior aspect of the medial malleolus (Figure 2).
7. An 8- to 10-MHz Doppler probe should be used. Doppler gel should be applied over the sensor.
8. After the Doppler device is turned on, the probe should be placed in the area of the pulse at a 45° to 60° angle to the surface of the skin. The probe should be moved around until the clearest signal is heard.
9. The cuff should be inflated progressively up to 20 mm Hg above the level of flow signal disappearance and then deflated slowly to detect the pressure level of flow signal reappearance. The maximum inflation is 300 mm Hg; if the flow is still detected, the cuff should be deflated rapidly to avoid pain.
10. The detection of the brachial blood flow during the arm pressure measurement should also be done by Doppler.
11. The same sequence of limb pressure measurements should be used. The sequence should be the same for clinicians within a same center.

(From Aboyens et al, 2012)

Interpretation

ABPI > 1.3 indicates arterial calcification

ABPI < 0.9 indicates PAD

ABPI < 0.4 or ankle systolic pressure < 50mmHg (70mmHg with ulcer) indicates severe or critical limb ischaemia

Discuss results with GP (PAD) or Vascular Team (CLI) as necessary, in addition to other clinical presenting factors (ulcers / pain) and clinical assessment findings

Appendix 5

Performing a toe systolic pressure assessment

Equipment needed

- Doppler unit
- Sphygmomamometer
- Toe cuffs
  and
- Photoplesythmography sensor (PPG)
  or
- 8mhz Doppler probe & ultrasound gel

Method

1. Rest the patient lying flat ideally, for at least 10 minutes (use this time to take a history and check foot and leg pulses)
2. Place toe cuff around the toe
3. Attach toe cuff to sphyg
4. If using PPG sensor, attach to apex of toe with surgical tape or similar and check that a pulse waveform has been located
5. If using 8 mhz Doppler, locate pulse waveform by using coupling gel and locating at distal sides or apex of toe
6. Inflate the sphyg cuff lightly and slowly until you see the waveform disappear. Note the pressure and continue to inflate until 20-30 mmHg above that pressure (super systolic)
7. Slowly release the pressure in the cuff at about 2 – 5 mmHg per second until the waveform reappears
8. This is the toe systolic pressure. Make a note of it
9. Deflate the cuff completely

Interpretation

Toe systolic pressure < 50mmHg indicates significant ischaemia
Toe systolic pressure < 30mmHg indicates critical limb ischaemia

Discuss results with Vascular Team as necessary, in addition to other clinical presenting factors (ulcers / pain) and clinical assessment findings

(Consensus by NW CEG, 2017)

Appendix 6

Wells DVT Score

For use in people presenting with suspected deep vein thrombosis (NICE CG 144, 2012).

Two-level DVT Wells score

Clinical feature	Points	Patient score
Active cancer (treatment ongoing, within 6 months, or palliative)	1	
Paralysis, paresis or recent plaster immobilisation of the lower extremities	1	
Recently bedridden for 3 days or more or major surgery within 12 weeks requiring general or regional anaesthesia	1	
Localised tenderness along the distribution of the deep venous system	1	
Entire leg swollen	1	
Calf swelling at least 3 cm larger than asymptomatic side	1	
Pitting oedema confined to the symptomatic leg	1	
Collateral superficial veins (non-varicose)	1	
Previously documented DVT	1	
An alternative diagnosis is at least as likely as DVT	−2	
Clinical probability simplified score		
DVT *likely*	2 points or more	
DVT *unlikely*	1 point or less	

Adapted with permission from:

- Wells PS et al. (2003) Evaluation of D-dimer in the diagnosis of suspected deep-vein thrombosis. New England Journal of Medicine 349: 1227–35
- The National Clinical Guideline Centre

If Wells Score is 2 or more, refer on using local DVT pathway for DVT diagnostic assessment or discuss Wells Score with the patients GP

Appendix 7

Examples of brief assessment and referral forms that clinicians can use, when suspecting peripheral arterial disease or critical limb ischaemia.

Pride in Pennine | Quality-Driven Responsible Compassionate

The Pennine Acute Hospitals NHS Trust

Peripheral Arterial Assessment and Referral Form

Patient details

Name	NHS Number DoB
Contact phone number (important):	

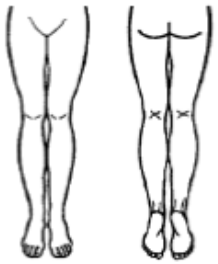
Known cardiovascular risks (circle)

Smoking history Diabetes Hypertension High cholesterol

Overweight / obese No cardiovascular exercise Carotid / coronary disease

Edinburgh Intermittent Claudication Questionnaire (Leng & Fowkes, 1992)

1. Do you get pain or discomfort in your legs when you walk? (If 'no' you do not need to continue with questions 2 - 5)	**Yes**	No
2. Does the pain ever begin when you are standing still or sitting?	Yes	**No**
3. Do you get this pain if you walk uphill or when you hurry?	**Yes**	No
4. Do you get this pain when you walk at an ordinary pace on the level?	**Yes**	No
5. Does this pain disappear when you rest for less than 10 minutes?	**Yes**	No



6. Where do you get the pain or discomfort? Mark the place(s) with an 'x' on the diagram.

Typical claudication, if in calf

Atypical claudication, if only in thighs or buttocks

Not claudication, if in the hamstrings, feet, shins, joints or radiates in the absence of calf pain

Foot Pulses	Right		Left	
	Palpable	Signal indicates	Palpable	Signal indicates
Posterior tibial	Y **N**	Tri Bi **Mono**	Y **N**	Tri Bi **Mono**
Dorsalis pedis / anterior tibial	Y **N**	Tri Bi **Mono**	Y **N**	Tri Bi **Mono**

Please tick as appropriate:

☐ Not previously been seen by the Leg Circulation Service or a Hospital Vascular Team

Refer to Leg Circulation Service for a peripheral arterial diagnostic assessment with <u>any</u> of the following:

☐ The Edinburgh Claudication Questionnaire is positive for leg pain / discomfort

☐ There are 2 non-palpable pulses in a foot <u>and</u> there are other cardiovascular risks or limb indications

☐ Monophasic Doppler signals at post tibial artery <u>and</u> there are other cardiovascular risks or limb indications

Or, consider referring to Secondary Care Vascular Team <u>urgently</u> if critical limb ischaemia is indicated after discussing with vascular clinician and GP:

☐ Cold, pulseless foot, with monophasic / non-audible Doppler signals
and severe pain at rest in toes / feet or tissue loss / necrosis

Additional comments:

Clinician:	Date:	Time:	Location:

If from GP Practice, please include the summary of medical history, current medicines and recent blood results
Fax / post all referrals to: The Leg Circulation Service, XXXXXXXXX XXXXXXX, XXXXXXX XXXX, XXXXXXXXX, Manchester, M9 XXX.
Tel 0161 XXX XXXX (Mon – Fri, 8.30am – 4.30pm) Fax 0161 XXX XXXX

Appendix 7 - cont

Pride in Pennine | Quality-Driven Responsible Compassionate

The Pennine Acute Hospitals NHS Trust

Critical Limb Ischaemia - Assessment and Referral Form

Patient details

Name Address	NHS Number DoB
Contact phone number (important):	
Usual GP:	

Known vascular related history (circle) Already known to Vascular Team at:

Smoking / Ex Diabetes Hypertension Hyperlipidaemia Chronic kidney disease

Carotid disease / TIA / CVA Ischaemic heart disease Angina Myocardial infarction

Peripheral arterial disease Angioplasty Bypass Other:

Minimal lower limb arterial assessment

Foot Pulses	Right			Left		
	Palpable? Y or N	Doppler signal (Tri / Bi / Mono)	Ankle systolic pressure mmHg	Palpable? Y or N	Doppler signal (Tri / Bi / Mono)	Ankle systolic pressure mmHg
Posterior tibial						
Anterior tibial						
Dorsalis pedis						

Critical limb ischaemia indicators (as per STAMP 2014 Guidelines)

☐ **Foot pulses non palpable** or ☐ **Handheld Doppler signals monophasic / absent**

Plus any of the following factors:

☐ **Ischaemic rest pain in toes or foot** Visual analogue score for pain (0 – 10):

☐ **New gangrene or necrosis in toes or foot**

☐ **Ankle systolic pressure < 50mmHg** (or < 70mmHg with existing foot or leg ulcer)

Severity of any associated infection – inflammation spreading from edge of foot ulcer or lesion

☐ None ☐ Mild < 2 cm ☐ Moderate 2cm – 5cm ☐ Severe > 5cm with or without systemic symptoms

ACTION: Ring Vascular Team via Vascular On-Call Registrar, if critical limb ischaemia is indicated

Decision: ☐ Admit within 24 hours ☐ Urgent Vascular outpatient appointment (within 7 days)

Name of Vascular Registrar contacted: Hospital:

☐ GP informed of admission or urgent referral ☐ Patient informed to take medicines and overnight items

Additional comments:

Clinician:	Date:	Time:	Location:

Appendix 8

Integrated pathways developed in the North West region - published and endorsed nationally, for both PAD and critical limb ischaemia.

NHS Manchester

The Pennine Acute Hospitals NHS Trust

Peripheral Arterial Disease (PAD) Integrated Care Pathway

(for patients with North and Central Manchester GPs)

Patient has a lower limb assessment by: GP, Nurse or Allied Health Professional

Baseline peripheral arterial assessment

Modifiable cardiovascular risks | Foot pulses | Leg symptoms | Doppler signals

No PAD
- Foot pulses palpable
- No intermittent claudication
- Doppler signals tri / bi phasic
- No ischaemic rest pain
- No clinical signs of PAD

Consider differential diagnosis

Suspected PAD
- Foot pulses non-palpable
- Symptoms of intermittent claudication
- Doppler signals monophasic
- Clinical signs eg skin / nail atrophy, cyanosed / pale cold feet, chronic wound, slow capillary refill time
- Sub-optimally managed existing PAD

Severe / critical limb ischaemia
- Foot pulses absent / not palpable OR
- Doppler signals monophasic / absent

PLUS any of the following
- Ischaemic rest pain (toes / feet)
- New gangrene or necrosis
- Ankle systolic < 50mmHg

Refer to the Leg Circulation Service for non-invasive lower limb vascular assessment, diagnosis / exclusion of PAD and an individually agreed management plan: education, lifestyle change, medicines, surgical options

Refer urgently to Hospital Vascular Team by contacting the Vascular Team or the on-call Vascular Registrar, if it appears urgent & limb threatening

Non-surgical management
- Early – moderate or stable PAD
- Individual management plan
- Review in 3 – 12 months, or if lower limb symptoms worsen

Refer for surgical opinion
- Severe / critical or worsening PAD
- Severe lifestyle impacting symptoms
- Ankle brachial pressure index < 0.4
- Ankle systolic pressure < 50mmHg

Follow up within 1 working day to ensure that Hospital Vascular Team has received and triaged the referral. Document this clearly in clinical notes.

All patients with a **confirmed diagnosis** of PAD should have an individually agreed management plan, which is to be reviewed periodically with their GP, the Leg Circulation Service or the Hospital Vascular Team.

The management plan will include discussing cardiovascular & limb risks and negotiating treatment options (lifestyle, medicines, surgery), to be reinforced by all Health Professionals involved in management of the lower limb

PAD / CV risk management	Target	Source
•Antiplatelet therapy	Initiate for all with established PAD	NICE CG 2012, SIGN 2006
•Lipid lowering therapy	Initiate for all with established PAD	NICE CG 2014, SIGN 2006
•Hypertension	BP < 140/90 mmHg	NICE CG 2011
•Smoking	Aim for quit	NICE CG 2012, SIGN 2006
•Obesity	BMI < 30	NICE CG 2014
•Moderate cardiovascular exercise	30 minutes, 5 times per week	DOH 2011
•Glycaemic control (if has diabetes)	HbA1c < 7.0 % or < 53 mmol/mol	NICE CG 2014, IFCC 2007

This pathway is based on PAD consensus from NICE, SIGN, TASC II, Target PAD and local expert opinion

(Fox et al, 2012)

Appendix 8 - cont

Peripheral Arterial Disease Integrated Care Pathway endorsed by:

Clinician	Position
Dr C Dang	Consultant Physician (diabetes), PAHT
J Dyce	Leg Ulcer Nurse Specialist, PAHT
M Fox	Vascular Specialist Podiatrist, PAHT
H Gordon	Podiatry Services Manager, PAHT
Mr M Hadfield	Consultant Vascular Surgeon, PAHT
J Harker	Nurse Consultant Tissue Viability, PAHT
Mr R Ibrahim	Consultant Vascular Surgeon, PAHT
Dr S Jackson	General Practitioner, Urban Village MC
S Lake	District Nurse Lead, PAHT
Mr M Madan	Consultant Vascular Surgeon, PAHT
B O' Shea	Practice Nurse, Urban Village MC
Mr T Oshodi	Consultant Vascular Surgeon, PAHT
M Proudman	Tissue Viability Nurse Lead, PAHT
D Ruff	Vascular Nurse Specialist, PAHT
Dr M Savage	Consultant Physician (diabetes), PAHT
L Smith	Vascular Nurse Specialist, PAHT
L Stuart MBE	Consultant Podiatrist, PAHT
P Yates	Principal Podiatrist, PAHT

Group / Team

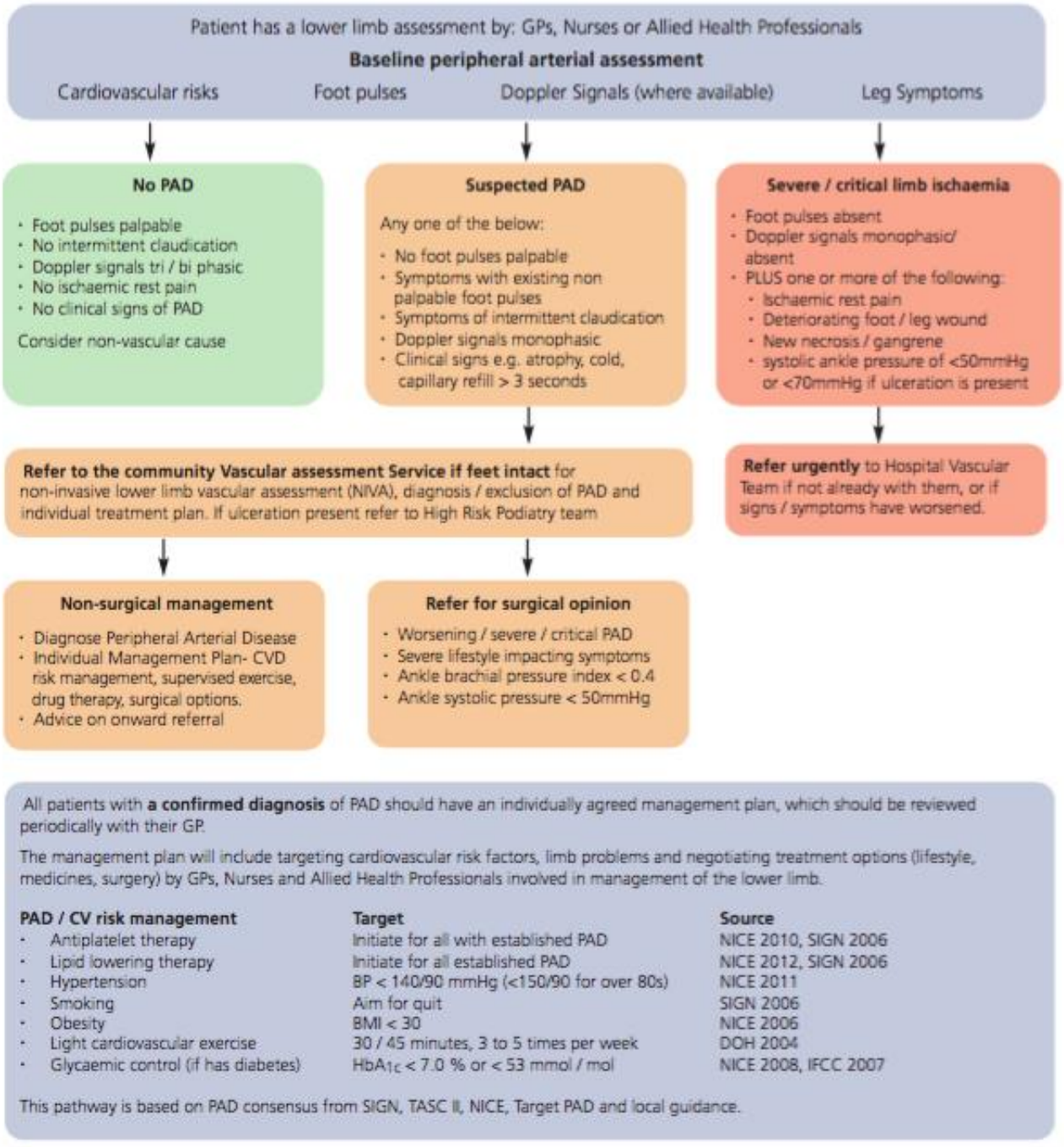
North Manchester High Risk Lower Limb Governance Group, PAHT

Medicine and Community Services Governance Group, PAHT

Surgical Division Governance Group, PAHT

Appendix 8 - cont

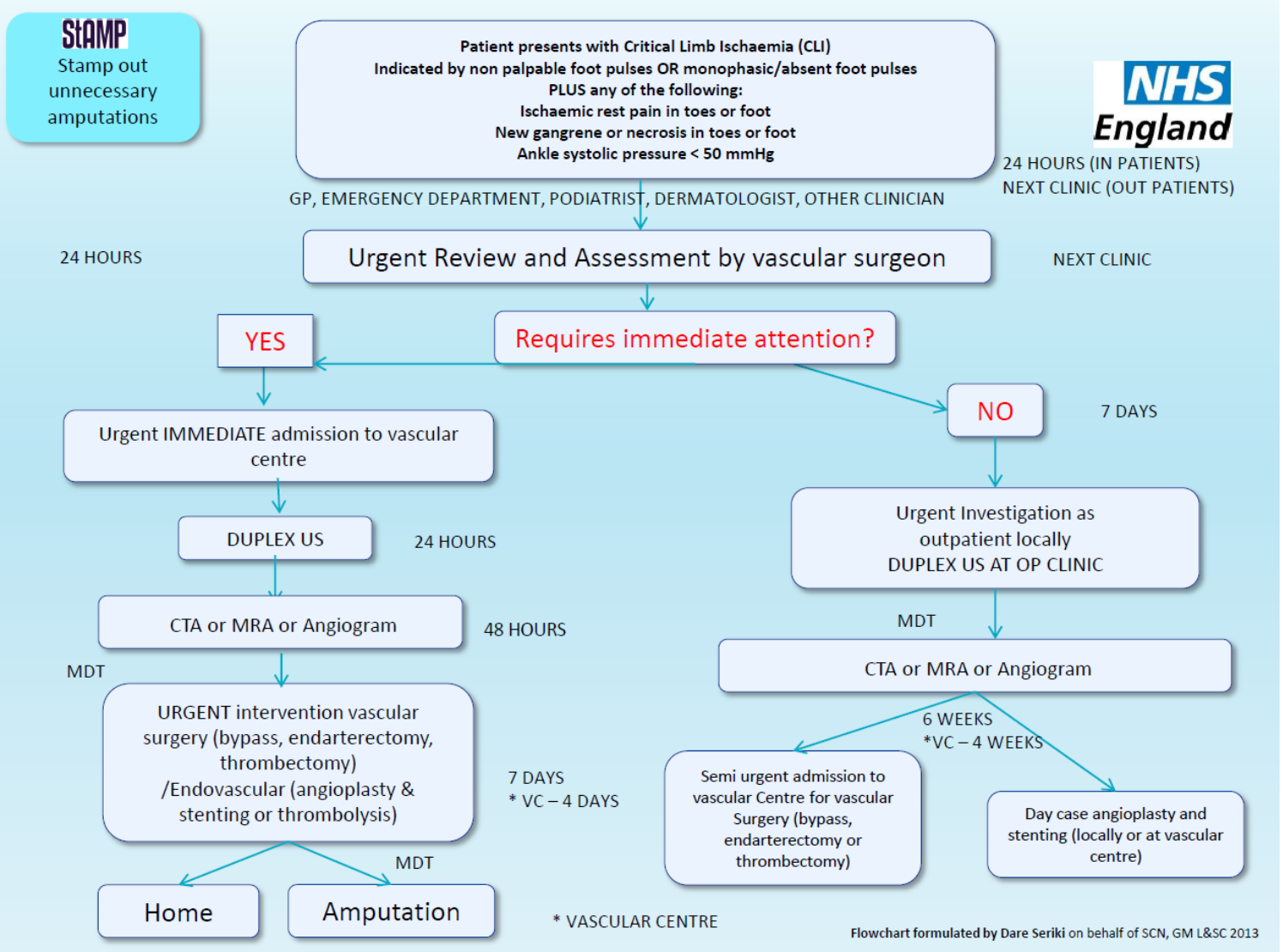
Salford Lower Limb Vascular Triage Service PAD Pathway



(Matthews et al, 2016)

Appendix 8- cont

STAMP Pathway for Critical Limb Ischaemia



Appendix 9 (NICE 2014 QS Audit tool)

These brief audit tool templates can be used to identify if a Lower Limb Clinic or Service is meeting the minimum quality standards for PAD, published by NICE (2014)

Blank audit template

PAD clinical benchmarking tool, for use with NICE PAD Quality Standard (2014)		
Target population: All adults seen with suspected PAD		
NHS organisation:		
Team:		
Date of benchmarking exercise:		
Clinician leading audit:		
Quality Statements (NICE 2014)	**Currently**	**%**
1. People who have symptoms of, or who are at risk of developing, peripheral arterial disease (PAD) are offered a clinical assessment and ankle brachial pressure index (ABPI) measurement.	red	0%
2. People with PAD are offered an assessment for cardiovascular comorbidities and modifiable risk factors.	red	0%
3. People with intermittent claudication are offered a supervised exercise programme.	red	0%
4. People with PAD being considered for revascularisation who need further imaging after a duplex ultrasound are offered magnetic resonance angiography (MRA).	red	0%
5. People with intermittent claudication are offered angioplasty only when imaging has confirmed it is appropriate, after advice on the benefits of modifying risk factors has been given and after a supervised exercise programme has not improved symptoms.	red	0%
Benchmarking exercise performed against 20 patients records		
Full evidence of Quality Standard being met in 80 - 100% of patients clinical records checked	green	
Some evidence of Quality Standard being met in 50 - 79% of patients clinical records checked	amber	
No evidence of Quality Standard being met in less than 50% of patients clinical records checked	red	

Example of completed audit template

PAD clinical benchmarking tool, for use with NICE PAD Quality Standard (2014)		
Target population: All adults seen with suspected PAD		
NHS organisation: Pennine Acute Hospitals Trust		
Team: Manchester Leg Circulation Service		
Date of benchmarking exercise: November 2016		
Clinician leading audit: Martin Fox		
Quality Statements (NICE 2014)	**Currently**	**%**
1. People who have symptoms of, or who are at risk of developing, peripheral arterial disease (PAD) are offered a clinical assessment and ankle brachial pressure index (ABPI) measurement.	green	100%
2. People with PAD are offered an assessment for cardiovascular comorbidities and modifiable risk factors.	green	100%
3. People with intermittent claudication are offered a supervised exercise programme.	green	80%
4. People with PAD being considered for revascularisation who need further imaging after a duplex ultrasound are offered magnetic resonance angiography (MRA).	red	?%
5. People with intermittent claudication are offered angioplasty only when imaging has confirmed it is appropriate, after advice on the benefits of modifying risk factors has been given and after a supervised exercise programme has not improved symptoms.	red	?%
Benchmarking exercise performed against 20 patients records		
Full evidence of Quality Standard being met in 80 - 100% of patients clinical records checked	green	
Some evidence of Quality Standard being met in 50 - 79% of patients clinical records checked	amber	
No evidence of Quality Standard being met in less than 50% of patients clinical records checked	red	

Contact the North West PAD Clinical Effectiveness Group for original copies of the audit tool or other forms or pathways in these appendices.

