

Knowledge of peripheral artery disease – what do the public, healthcare practitioners and trainees know?

Bernadeta Bridgwood, Andrew Nickinson, John Houghton, Coral Pepper, Rob Sayers  
Published in *Vascular Medicine* (2020)

## **Abstract**

This systematic review evaluated the knowledge and awareness of peripheral artery disease (PAD) within the general public (including patients with peripheral vascular disease), non-specialist healthcare professionals (nsHCP) and trainees (medical students and trainee doctors). Relevant articles were identified from electronic databases using key search terms: “peripheral artery disease”; “limb ischaemia”; “intermittent claudication”; “knowledge”; “understanding”; “public” “medical professional”. The heterogeneous results were described narratively. A lack of knowledge and understanding of PAD (disease awareness) were identified in all groups. Among nsHCPs, factors which affect knowledge include the level of training, early clinical exposure and the presence of family members with cardiovascular/vascular disease. Within the general public, knowledge and awareness was improved if a family member/friend had a diagnosis or following a patient-centred consultation with any HCP. Public campaigns are proven effective in improving disease knowledge/awareness in conditions such as stroke alongside sustained patient education. These may provide future avenues to improve PAD knowledge and awareness, in order to effectively manage risk factors and minimise delayed or missed diagnosis of PAD. (PROSPERO registration number: CRD42018117304).

**Keywords:** Peripheral artery disease (PAD); knowledge; awareness; patient education; medical education; public; intermittent claudication, healthcare professional

## Introduction

Peripheral artery disease (PAD) describes the impairment of blood flow to the peripheries due to atherosclerotic disease. Although the total number of deaths due to circulatory disease has decreased, they represented 31% of all global deaths in 2016 [1]. PAD is estimated to be present in a fifth of those aged over 60 and carries an increased risk of cardiovascular disease and stroke [2]. In the majority of patients, PAD is asymptomatic. However, when symptoms do arise, they can cause functional impairment and decreased quality of life [3]. A community-doctor working in general practice with an average patient list of 3500 patients would expect to manage approximately 100 patients with PAD [4].

PAD has long been under-diagnosed and it is estimated that up to half of all people with PAD are undetected [5,6]. In order to make a timely diagnosis, a patient must identify they have a medical issue and present themselves to healthcare services. Alternatively, any healthcare professional should appreciate patient risk factors and undertake opportunistic screening [4]. Considering a possible diagnosis, followed by a carefully taken patient history and appropriate examination including an ankle-brachial pressure index (ABI), are all important in the recognition of PAD [2,7].

Several reasons have been postulated for the lack of detection, of which the most common are the high prevalence of asymptomatic disease and the inappropriate use of screening and diagnostic tools [3,8]. Individual studies have recognised poor awareness of PAD within individual populations. However, these findings have not been correlated and compared across multiple study populations. In order to develop interventions to improve knowledge, greater understanding of the determinants of PAD knowledge by non-specialist healthcare professionals is required. These

include multiple disciplinary professionals including general practitioners, nurses and podiatrists, who are often the first contact patients have with healthcare services. Equally, it is also important to determine the current level of patient/public knowledge to evaluate whether the current provision provides adequate education and opportunity to assess their risk of disease. Ultimately, improved knowledge aims to improve health quality outcomes.

The aims of this review are: (1) to identify the current level of knowledge regarding PAD in patients/public, (2) to identify the current level of knowledge regarding PAD in non-specialist healthcare professionals (nsHCPS) and trainees; (3) to evaluate factors determining knowledge levels.

## **Method**

PRISMA guidelines were followed to identify articles where the main focus of the study was knowledge of PAD [9]. A search of electronic databases (MEDLINE, Embase, The Cochrane Library (Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials (CENTRAL), Cochrane Methodology Register, CINAHL, Scopus and Gray literature) of all available articles, was conducted by CP and BB (December 2018), using combinations of the following keywords and thesaurus headings: “peripheral artery disease”; “limb ischaemia”; “intermittent claudication”; “knowledge”; “understanding”; “public” “medical professional”. Bibliographic lists were scanned for additional relevant articles. The search was repeated on 30th April 2019.

A study protocol was registered at the International Prospective Register of Systematic Reviews (PROSPERO) (registration number: CRD42018117304).

### *Eligibility criteria*

All quantitative and qualitative studies relating to this topic were included if they presented cognitive PAD knowledge. Articles which related solely to relevant performing practical skills (e.g. ABI) were excluded. For breadth, conference abstracts were also included. Only English language articles were considered.

### *Types of participants*

This study investigated knowledge of PAD in three adult groups (aged 18 years or older).

1. The general public, including individuals who had a presumed or confirmed diagnosis of PAD.
2. Practicing healthcare professionals who are not specialised in managing PAD or its complications: 'non-specialist' healthcare professionals (nsHCP). nsHCPs included general practitioners, nurses and podiatrists.
3. Training healthcare professionals, including medical or nursing students.

### *Definition of PAD*

For the purposes of this review, where appropriate, an ABI ratio of less than 0.9, a confirmed diagnosis of PAD within patient records, or a history of previous revascularisation procedure were used to indicate the presence of PAD [2,10].

### *Data extraction*

Search results were imported into EndNote™ X9 (Clarivate Analytics®) and duplicates removed. Titles and abstracts were reviewed independently for potential suitability against the inclusion criteria by investigators BB and AN. The full texts of suitable studies were retrieved and independently assessed for final inclusion by BB and AN, or JH. A standardised data extraction form was created and tabulated into Excel™ 2016 (Microsoft®). Data extraction was performed independently by BB and AN, or JH. Cases of disagreement were resolved by discussion within the team.

### *Study quality*

The quality of these studies was assessed using the complement of critical appraisal tools provided by the Joanne Briggs Institute [11-13]. This considered the evidence in each study with relation to our research questions throughout a series of domains. We graded the study quality as high (all domains satisfied), moderate (one domain unsatisfied or unknown) or low (more than one domain unsatisfied). Currently, no tool exists for assessment of conference abstracts.

Evaluation of quality was performed independently by BB and AN, or JH, after data extraction and disagreement was resolved through discussion. All studies were included, irrespective of their quality.

### *Strategy for data synthesis*

A narrative synthesis of results, structured around the knowledge and awareness of PAD, and determining factors for knowledge within the three groups was performed and the data were tabulated where appropriate. Given the anticipated heterogeneity of results, a meta-analysis was not undertaken.

## **Results**

A total of 27 articles were identified as meeting the eligibility criteria (Figure 1). Table 1 summarises the characteristics of the studies. Table 2 gives an overview of the included participants. The quality of the studies focused on nsHCP were deemed high=1, moderate=6 and low=2. For those focused on public/patients, study quality was deemed as high=7, moderate=4, low=7 (Supplementary information).

Figure 1

Table 1

Table 2

### **Knowledge of PAD – patient/public**

Nineteen studies explored PAD knowledge within patients/public [5, 8,14-31], of which six studies focused on risk factor awareness [8,15,18,20,23,25].

#### *Understanding PAD*

Awareness of PAD ranged across the studies from 21% [25] to 60.5% [24]. When asked to classify its severity, PAD was considered an innocent condition by 25%, relatively serious by 61% and very serious by 5%. PAD symptoms were described as a 'pain in the legs that subsides during rest' and 'pain during walking'. Willigendael found that participants had 'heard of' PAD (50%) but were less familiar with the term intermittent claudication (5%). Gorely and Tomczyk provided terms used by patients which give insight into their understanding of PAD. Descriptions included "a blockage

with plaque or fat”; “hardening of the arteries, where blood just doesn’t flow properly” and “it’s kind of a blockage of the artery” [21,27]. Colloquial terms such as ‘window-shopping legs’ more commonly recognised by the Dutch, are also used, which may add to confusion [29].

Wann-Hansson reported patients/public generally felt they had insufficient knowledge of both cardiovascular and peripheral vascular disease [28]. Even when participants thought that they had good awareness of PAD, they had low overall knowledge of the clinical features of the condition [26]. There was confusion with other diagnoses such as chronic venous diseases and musculoskeletal injuries [14,15,27,29]. Wann-Hansson reported that participants assumed that symptoms would dissipate with time or identified them with ‘expected’ pain with older age [28, 31].

Muthu reported improved knowledge following a consultation with a specialist healthcare professional; although 4% remained unaware of their vascular diagnosis [25]. Chang reported 90% of patients treated at a vascular clinic knew their diagnosis, where 88% of these identified the correct diagnosis and 78% were aware of the importance of secondary prevention [18]. In the same study, 68% of participants reported they had never discussed PAD or risk reduction. When a relative or friend had PAD, 10% more participants were able to describe universally recognised PAD symptoms [29]. Hirsch noted participants gained knowledge regarding PAD mostly from non-medical sources including from family and friends, the internet and books [5].

### *Risk factors*

Knowledge regarding PAD risk factors varied between the studies (Table 3). There was a general lack of knowledge regarding causes of PAD, despite the presence of multiple risk factors [14,17,22]. Although specialist assessment improved awareness of some risk factors such as smoking (73% vs 90%  $p = 0.028$ ) and diabetes (23% vs 66%  $p = 0.028$ ), Muthu did not report an increased awareness of any other PAD associated risk factor [25]. Hirsch highlighted that reduced risk factor recognition was associated with older age, lower educational level and income [5], something which was corroborated by Coughlin [19]. Some ex-smokers continually denied a correlation between smoking and PAD, or needed confirmation and encouragement to continue their non-smoking status [28,31].

#### *Knowledge of PAD Consequences*

Two studies investigated the awareness of the associations between PAD and other medical conditions with results varying hugely. Between 28% [23] and 94% [8] of respondents recognised an association with stroke disease; 25% recognised an association with myocardial infarction [5] and 78% with coronary heart disease [8]. The highest level of recognition was seen with diabetes at 98% [8]. Awareness of the association between PAD and amputation varied between 14% [5] and 60% [8] and only 14% associated PAD with an increased risk of death [5]. Cronin did not find any increased awareness of PAD in those patients who had previously suffered any of the above conditions [8].

#### *Knowledge of PAD management*

Although participants had a general awareness of self-management which included smoking cessation, weight loss and regular exercise, these were often without

substance or active implementation plans [23]. Uncertainty and lack of motivation was repeatedly noted by participants as a barrier for implementation of self-management, particularly activity-induced pain. One participant in this study stated “[E]xercises causes pain which you’re trying to get rid of”. However, knowledge was increased and retained when individuals received tailored management on a regular basis [5,16]. For example, Hirsch reported a 14% improvement in management knowledge between a first and second visit, with further knowledge improvement during subsequent visits [5].

### **Knowledge of PAD – non-specialist healthcare professionals**

Knowledge of non-specialist healthcare professionals (nsHCP) was evaluated within three studies. Knowledge of PAD was classified into disease awareness, adherence to evidence based guidance and risk factor recognition [5,32-33].

Screening a population of patient’s with PAD, Hirsch reported that only 49% of patients screening positive for the condition had been diagnosed by their usual primary care doctor [5]. Haigh’s survey reported just 6% of GP respondents were aware of PAD guidance where 61% of these GPs screened patients for PAD. These GPs were prompted to screen by the presence of risk factors such as smoking and type II diabetes [32]. Screening mainly took the form of history and examination, followed less often by ABI (54%) or duplex ultrasound scanning (42%) [32]. Barriers to screening included lack of knowledge, equipment, training and skills [32].

Normahani surveyed UK podiatrists and found a correlation between level of vascular education, clinical-training and confidence in recognising vascular foot problems and appropriate referrals [33]. Awareness and recognition was generally

improved if nsHCP had increased clinical exposure to PAD, received training to perform ABI and if patients displayed classic symptoms such as leg claudication [5].

### **Knowledge of PAD - trainees and students**

PAD knowledge of medical students and trainee doctors was tested using questionnaires and during formal examinations within six studies [14,34,-38]. Overall knowledge was rated at modest to poor for data gathering and its interpretation during practical exams. It was improved if there was a personal or family history of cardiac disease. Although Chaudru reported 21% of students were familiar with ABI guidance; only 11% were able to perform an ABI [34].

Godshall introduced an educational programme for second year medical students, containing didactic lectures and a problem based-learning session. Here, knowledge scores were comparable with third year medical students unexposed to this module [38]. This suggests increased level of training and early clinical exposure vascular disease training may be as valuable as teaching to improve knowledge.

An overview of the recommendations to improve PAD knowledge in all groups is presented in Figure 2.

### **Discussion**

This systematic review examined 27 articles which focused on PAD knowledge in order to evaluate the level and determinants of PAD knowledge in patients/public,

non-specialist healthcare professionals and respective trainees. Knowledge of PAD, its risk factors, consequences and management varied across the studies, with clearly recognised knowledge inadequacy alongside uncertainty of its potential seriousness. These findings are consistent across the studies despite the varying levels of the quality of the studies.

Delays in the presentation and appropriate management of PAD may lead to complications such as ischemia, amputation and death [39]. To initiate timely treatment, patients must first recognise their symptoms and seek medical attention. Following this, nsHCPs need to suspect the potential for PAD to refer, investigate or initiate secondary prevention. It is therefore important to identify the knowledge of nsHCPs, who are often the first-line in consulting patients, in order to offer insight into the problem of PAD under-recognition and delays in presentation from both sides of the consulting room. Several determinants of knowledge have been identified for nsHCPs and patients/public which give opportunities to focus efforts to improve PAD knowledge, recognition and subsequent management.

### ***Patient/public and PAD***

There appears to be misconceptions in the differences between PAD and other common conditions, such as musculoskeletal disorders and what should be considered normal within the aging process. This is compounded by poor understanding of the basic pathophysiology of PAD by patients/public which may reduce the ability to correlate risk factors. PAD is often referred to by numerous terms by patients/public and nsHCPs, which may add further uncertainty.

Public understanding of PAD and personal risk was often translated through knowledge and experience of friends/relatives, social media and public opinion and campaigns [34]. The Act Fast campaign in the United Kingdom pursued TV adverts with national media coverage, in order to improve stroke knowledge and recognition. Dombrowski identified the campaign results in high levels of stroke awareness amongst the public [40]. Flynn also noted increased information seeking behaviour with increased presentation to medical services [41]. The National Heart Lung and Blood Institute (NHLBI) within the USA, had co-implemented a national PAD awareness campaign for the public and healthcare providers, which offer education events and resources to improve PAD knowledge. Here, there are opportunities to re-invigorate and utilise increasingly popular methods of patient education particularly online and social media [42,43]. In the UK, the Putting Feet First campaign led by Diabetes UK provides a further opportunity to raise awareness of PAD [44].

For individual patients, knowledge was improved when they received individually tailored management. When practitioners have an understanding of their patient's knowledge of PAD, this provides an opportunity for a patient-centred consultation using terminology a patient can clearly understand. Despite this, Hirsch identified that only a small number of individuals received PAD information from a non-specialist or specialist practitioner [23]. A meta-analysis of educational and behavioural interventions to improve stroke risk factors did not show any effect on several risk parameters within stroke management, although some improvements were observed when these were delivered by MDT's [45].

Diabetes literature provides examples of effective patient therapeutic education, particularly when performed by a MDT, facilitating the opportunity for several specialities to be involved in the patient care – and multiple opportunities for patient education [45-47]. These may reflect the ability to spend time with a patient and provide effective communication. Heiler found that this positively correlated with greater self management regardless of confounders including sociodemographic and health variables [48]. However, evidence suggests that tailored education should be sustained and intensive from specialist and non-specialist multi-disciplinary team members to ensure ongoing patient engagement [49,50].

### ***Health care professionals***

All health professionals – specialist and non-specialist, should be aware that a large proportion of patients with PAD are asymptomatic and patients may progress to a point of irreversible damage, including higher mortality rates, before diagnosis [51].

For front-line and community-based nsHCPs, which include doctors, nurses and podiatrists, demands for the recognition of disease within a single consultation are often complicated by multi-morbidity, quality outcomes assessment and patient demands. This may lead to missed opportunities for disease recognition and diagnosis. This has been seen within cancer diagnosis whereby a patient presents with complex symptomology which can complicate the exploration and recognition of signs and symptoms: the so called ‘competing demands theory’ [52].

Alternatively, health-professionals may incorrectly attribute symptoms to existing conditions, for example osteoarthritis (OA) [53]. The cognitive assessment of disease

by nsHCPs has been the subject of a recent study involving functional magnetic resonance imaging [54]. Here, decision making was related to a reduction of uncertainty about a diagnosis [54]. How nsHCPs determine whether a symptom may be attributed to PAD and uncertainty surrounding this decision would provide important insights into PAD recognition and stimulate the development of strategies to increase disease recognition.

### ***Trainees and students***

Increased knowledge of PAD was observed when nsHCPs/trainees were exposed to early vascular clinical experience, had a greater level of training or experience of cardiovascular disease [55]. Adult learning theory holds that people learn new knowledge and skills most effectively when they are presented in the context of the application of new knowledge within real-life situations [56]. Teaching methods for trainees could include early patient contact/clinical experience, multi-media and utilise smart phones for teaching [57,58]. These may be with virtual or real patients – both are documented to promote meaningful theory learned using visual, audio and verbal experiences and acquire complex skills and knowledge [58].

Early clinical experience provides context to theoretical learning and improves the understanding to apply new knowledge [59,60]. This includes how patients describe symptoms and how practitioners may recognise disease. For example, with the knowledge that PAD often presents with similar features to other diseases, such as OA, trainees may be taught to screen for PAD alongside OA. Future research aims to provide an insight into exposure and training of PAD within medical schools correlated with trainee awareness, knowledge and confidence in its recognition. Using quantitative methods including direct knowledge testing and qualitatively

exploring student knowledge would provide an understanding of how educational curriculum provides future nsHCPs with the tools to recognise and prevent diseases. Equally if there are additional educational resources required to improve PAD knowledge.

While practitioners are expected to engage in continuing professional development to update their knowledge, there is a rapidly expanding landscape of medical information, provision of guidelines and more conditions to diagnose. There is a plethora of platforms to provide educational material for nsHCPs including web-based learning, interactive group discussion, individual learning and group learning [60,61]. Although there are more resources available online, group learning which would allow for essential practical skills training which would be most suitable for PAD [61,62]. Future research should evaluate the knowledge of health-professional at different stages of training, including the associated clinical reasoning, to identify effective education interventions to improve PAD knowledge.

### **Strengths and Limitations**

This is the first review of publications concerned with knowledge of PAD to identify the levels of knowledge with insight into its determinants within the patients/public, health-professionals and their trainees. The studies consistently report low levels of knowledge within the groups which highlights an opportunity to improve knowledge and hence management of this important disease. There are, however, limitations which impact the quality of the review. The heterogeneous nature of the studies did not enable direct comparisons of the methods, settings and knowledge measure nor could a meta-analysis be undertaken. The results gathered were presented for

trainee doctors, GPs, nurses and podiatrists. Despite a broad search strategy, no information is known about the knowledge of other specialities such as general-internal medicine, emergency medicine, cardiovascular and endocrine medicine within the available literature. It is recognised that within different countries, patients may first encounter these specialists. However, the information gained provided both qualitative and quantitative outcomes.

A number of studies included in this review (70%) were of low or moderate quality. Studies were particularly at risk of selection and reporting bias, and many had relatively small sample sizes. While results were relatively consistent across all studies, they should be interpreted with this risk of bias in mind which limits the strength of the conclusions of this review. Inclusion of a conference abstract raises contention as vital study details may not be provided and there may be little peer review before publication. Although removing this study would have increased the overall study quality, it would have limited the scope of this deliberately broad study.

## **Conclusion**

Knowledge of PAD is lacking in both patients/public and nsHCPs. Knowledge levels could be improved through educational interventions such as individually tailored patient education or greater clinical exposure to increase patient and nsHCP knowledge and recognition for earlier PAD treatment. We contend that education is both a critical component of an individual's health and a contributing cause of other elements of the individual's concurrent and future health. When PAD awareness gaps are improved

by access to knowledge, an informed patient is best positioned to diminish risk in collaboration with an informed clinical provider.

## **Disclosures**

Nil

## **Funding**

Andrew Nickinson and John Houghton are funded and Bernadeta Bridgwood and Rob Sayers are partially funded through the George Davies Charitable Trust. The trust had no role in the study design, analysis, manuscript preparation or any publication decisions. All researchers acted independently with no conflicts of interest. (Registered Charity Number: 1024818).

## **Acknowledgements**

The authors would like to thank George Davies and the George Davies Charitable Trust for the generous charitable donation that funded this work.

## **References**

1. [https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)) (2017, accessed 28 August 2019).
2. National Institute for Health and Clinical Excellence. Lower limb peripheral arterial disease: diagnosis and management. (Clinical guideline 147.) 2012.
3. Aronow H. Peripheral arterial disease in the elderly: recognition and management. *Am J Cardiovasc Drugs*. 2008;8(6):353-64.
4. Wilkes S, Stansby G, Sims A *et al*. Peripheral arterial disease: diagnostic challenges and how photoplethysmography may help. *Br J Gen Pract* 2015;65(635):323-324.
5. Hirsch AT, Criqui MH, Treat-Jacobson D *et al*. Peripheral Arterial Disease Detection, Awareness, and Treatment in Primary Care. *JAMA*. 2001;286(11):1317-24.

6. El-Menyar A, Al Suwaidi J Al-Thani H. Peripheral arterial disease in the Middle East: Underestimated predictor of worse outcome. *Glob Cardiol Sci Pract*. 2013;2013(2):98–113.
7. Gornik H, Beckman J. Peripheral Artery Disease. *Circulation*. 2005;111(13):e169–e172
8. Cronin C, McCartan D. Peripheral Artery Disease: A Marked lack of awareness in Ireland. *Eur J Vasc Endovasc Surg*. 2015;49:556-562.
9. Moher D, Liberati A, Tetzlaff J et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS medicine* 2009; **6**: e1000097-e.
10. European Stroke Organisation, Tendera M, Aboyans V, Bartelink M, et al. ESC Guidelines on the diagnosis and treatment of peripheral artery diseases. *Eur Heart J*. 2011;32(22):2851-2906.
11. The Joanna Briggs Institute Critical Appraisal tools for use in JBI Systematic Reviews Checklist for Systematic Reviews and Research Syntheses <http://joannabriggs.org/research/critical-appraisal-tools.html> (2017, accessed 12 December 2018).
12. Lockwood C, Munn Z, Porritt K. Qualitative research synthesis: methodological guidance for systematic reviewers utilizing meta-aggregation. *Int J Evid Based Healthc*. 2015;13(3):179–187.
13. Moola S, Munn Z, Tufanaru C, Aromataris E, Sears K, Sfetcu R, Currie M, Qureshi R, Mattis P, Lisy K, Mu P-F. Chapter 7: Systematic reviews of etiology and risk . In: Aromataris E, Munn Z (Editors). *Joanna Briggs Institute Reviewer's Manual*. The Joanna Briggs Institute, 2017. Available from <https://reviewersmanual.joannabriggs.org/>
14. AlHamzah M, Eikelboom R. Physicians' peripheral arterial disease knowledge gap starts in medical school. *J Vasc Surg. Conference: 39th annual meeting of the Canadian society for vascular surgery vascular surgery, CSVS 2017*. Canada. 2017;66(3):e84.
15. Aboyans V, Lacroix P. The level of knowledge of risk factors for peripheral arterial disease also depends on subjects' individual clinical situations. *Can J Card*. 2009;25(9):545.
16. Batista F, Pinzu M. Disease Knowledge in Patients Attending a Diabetic Foot Clinic. *Foot & Ankle Int*. 2005;26(1):38-41.
17. Bush R, Kallen M. Knowledge and Awareness of Peripheral Vascular Disease Are Poor Among Women at Risk for Cardiovascular Disease. *J Surg Res*. 2008;145:313–319.
18. Chang V, Handa K. Improving cardiovascular prevention through patient awareness, *Rev Assoc Med Bras* 2012; **58**(5):550-556.
19. Coughlin P, Gulati V. Risk factor awareness in patients with peripheral arterial disease. *J Card Surg*. 2007;48:735-740.
20. Crisan S, Pestre C. Testing the knowledge of risk factors for atherosclerosis in women with peripheral arterial disease. Abstracts, 10th Annual Spring Meeting on Cardiovascular Nursing/European Journal of Cardiovascular Nursing. 2010;9(1):S23.
21. Gorely T, Crank H. Standing still in the street: Experiences, knowledge and beliefs of patients with intermittent claudication – a qualitative study. *J Vasc Nurs*. 2015;33:4-9.

22. Lovell M, Harris K, Forbes T, et al. On behalf of the Peripheral Arterial Disease Coalition. Peripheral arterial disease: Lack of awareness in Canada. *Can J Cardiol.* 2009;25:39-45.
23. Hirsch A, Murphy T, Lovell M, et al. Gaps in Public Knowledge of Peripheral Arterial Disease Circulation. 2007;116:2086-2094.
24. Martinez G, Gutierrez F, Gallego G et al. Design, validation and clinical application of a knowledge questionnaire (ConocEAP) in patients with peripheral arterial disease. *Angiologia.* 2017;69(1)4-11.
25. Muthu C, Chu J. Patient awareness of risk factors for peripheral vascular disease. *Ann Vasc Surg.* 2007;21(4)433-7.
26. Morr C, AlHamzah M, Ng P, et al. Knowledge of peripheral arterial disease: Results of an intervention to measure and improve PAD knowledge in Toronto. *Vascular.* 2017;27(5)479-487.
27. Tomczyk S, Treat-Jacobson D. Claudication symptom experience in men and women: is there a difference? *J Vasc Nurs* 2009;27(4)92-97.
28. Wann-Hansson C, Wennick A. How do patients with peripheral arterial disease communicate their knowledge about their illness and treatments? A qualitative descriptive study. *BMC Nurs.* 2016;15;1-9.
29. Willigendael E, Teijink A, Bartelink M, et al. Peripheral arterial disease: Public and patient awareness in the Netherlands. *Eur J Vasc Endovasc Surg.* 2004;27(6):622-628.
30. Zhuge Y, Schulman C, De La Cruz M, et al. Patient awareness on vascular disease risk factors? A study of 916 volunteers. *J Vasc Surg,* 2010;51:6(1):61S-62S.
31. Treat-Jacobson D, Halverson S, Ratchford A et al. A Patient-derived Perspective of Health-related Quality of Life With Peripheral Arterial Disease. *J Nurs Sch.* 2002;34(1):55-60.
32. Haigh K, Bingley J. Barriers to screening and diagnosis of peripheral artery disease by general practitioners. *Vasc Med.* 2013;18(6) 325 –33.
33. Normahani P, Mustafa C, Standfield N, et al. Management of peripheral arterial disease in diabetes: a national survey of podiatry practice in the United Kingdom. *J Foot Ankle Res.* 2018;11,29.
34. Chaudru S, de Müllenheim P. Knowledge about ankle-brachial index procedure among residents: being experienced is beneficial but is not enough. *Vasa.* 2016;45(1)37 – 41.
35. Endean E, Sloan S. Performance of the vascular physical examination by residents and medical students. *J Vasc Surg.* 1994;19:149-156.
36. Schwarcz A, Quijano A Olin J, et al. Internal medicine interns have a poor knowledge of peripheral artery disease. *Angiology.* 2012;63(8)597-602.
37. Stivalet O, Omarjee L, Chaudru S, et al. Noninvasive Peripheral Artery Disease Screening Tools: A Deficient Knowledge among French Vascular Residents from 4 Medical Schools. *Ann Vasc Surg.* 2018;47:134-142.
38. Godshall C, Moore P. A vascular disease educational program in the preclinical years of medical school increases student interest in vascular disease. *J Vasc Surg.* 2010;52:775-81.
39. Nickinson A, Bridgwood B, Houghton J et al. A systematic review investigating the identification, causes and outcomes of delays in the management of chronic limb threatening ischaemia and diabetic foot ulceration. *J Vasc Surg.* In press.

40. Dombrowski S, Mackintosh J, Sniehotta F, et al. The impact of the UK 'Act FAST' stroke awareness campaign: content analysis of patients, witness and primary care clinicians' perceptions. *BMC Public Health*. 2013;13:915.
41. Flynn D, Ford G. A Time Series Evaluation of the FAST National Stroke Awareness Campaign in England. *PLOS*. 2014; 9(8):e104289. Allmark P, Tod A. J How should public health professionals engage with lay epidemiology? *Med Ethics*. 2006;32(8):460-463.
42. Ahmed W, Bath P. et al. Measuring the effect of public health campaigns on Twitter: the case of World Autism Awareness Day. In: *Transforming Digital Worlds. iConference 2018: Transforming digital worlds. Lecture note in Computer Science*. Springer Verlag pp10-16, <http://eprints.whiterose.ac.uk/127215/> (2018, accessed 21 May 2019).
43. Castandeda P, Sales A, Osborne N et al. Scope, Theme and Medical Accuracy of eHealth. *Peripheral Artery disease. Community Forums. Ann Vasc Surg*. 2019;54:92-102.
44. [https://www.diabetes.org.uk/get\\_involved/campaigning/putting-feet-first](https://www.diabetes.org.uk/get_involved/campaigning/putting-feet-first) (2019, accessed 29 July 2019).
45. Bridgwood B, Lager K, Mistri A, et al. Interventions for improving modifiable risk factor control in the secondary prevention of stroke. *Cochrane Database of Systematic Reviews* 2018, Issue 5. Art. No.: CD009103.
46. Holt R, Diabetes education, education and education. *Diab Med*. 2017;34(8);1023-24.
47. Smith K, Baker K. Redesigning hospital diabetes education. A qualitative evaluation with nursing teams. *J Nur Care Qual*. 2019;34(2):151-157.
48. Heiler M, Bounight E. The relative importance of physician communication, participatory decision making, and patient understanding in diabetes self-management. *J Gen Intern Med*. 2002;17:243-252.
49. Adiewere P, Gillis R, Jiwani I, et al. A systematic review and meta-analysis of patient education in preventing and reducing the incidence or recurrence of adult diabetes foot ulcers (DFU). *Heliyon*. 2018;4:e00614.
50. Dorreesteijn J, Kriegsman D, Assendelft W, et al. Patient education for preventing diabetic foot ulceration. *Cochrane Database of Systematic Reviews*. 2012, Issue . Art No CD00148. DOI10.1002/14651858. CD01488.pub4.
51. Pande R, Perlstein T, Beckman J, et al. Secondary Prevention and Mortality in Peripheral Artery Disease. *National Health and Nutrition Examination Study, 1999 to 2004. Circulation*. 2011;12(1):17-23.
52. Mounce L, Price S, Valderas J, et al. Comorbid conditions delay diagnosis of colorectal cancer: a cohort study using electronic primary care records. *Br J Canc*. 2017;116:1536-1543.
53. Walker C, Bunch F. Multidisciplinary approach to the diagnosis and management of patients with peripheral arterial disease. *Clin Interv Aging*. 2015;10;1147-1153.
54. Melo M, Gusso G. How doctors diagnose diseases and prescribe treatments: an fMRI study of diagnostic salience. *Sci Rep*. 2017;7:1304.
55. Hosseinpour A, Bergen N, Scholothauber A et al. National health inequality monitoring: current challenges and opportunities *Global health Action*. 2018;11(1):70-74.
56. Khorsand D, Khwaja A, Schmale G. Early musculoskeletal classroom education confers little advantage to medical student knowledge and competency in the absence of clinical experiences: a retrospective comparison study. *BMC Med Edu*. 2018;18(1)46.

57. Mughal N, Atkins E. Smartphone learning as an adjunct to vascular teaching – a pilot project. *BMC Med Educ.* 2018;18:37
58. Bell K, Boshiozen H. When only the real thing will do: junior medical students' learning from real patients. *Med Educ.* 2009;43(11):1036-1043.
59. Wenrich M, Jackson M, Wolfhagen I, et al. What are the benefits of early patient contact? - A comparison of three preclinical patient contact settings. *BMC Med Ed.* 2013;13:80.
60. Ali K, Zahra D, McColl E, et al. Impact of early clinical exposure on the learning experience of undergraduate dental students. *Eur J Dent Educ.* 2018;22:e75–e80.
61. Yee M, Simpson-Young V, Paton R, et al. How do GPs want to learn in the digital era? *Aust Fam Phy.* 2014;43(6):399-402.
62. MacWalter G Mckay J, Bowie P. Utilisation of internet resources for continuing professional development: a cross-sectional survey of general practitioners in Scotland. *BMC Medl Ed.* 2016;16:24.

## Figures

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram of information through the different phases of the systematic review

Figure 2 Overview of the recommendations to improve peripheral arterial disease (PAD) knowledge within healthcare professionals and patients/public.

Table 1 Overview of the characteristics of the studies.

Shading in column two denotes full paper; no shading denotes abstract only (Crisan). Non-specialist healthcare professional (nSHCP); years (y); female (F); male (M); peripheral artery disease (PAD). Study quality assessed by critical appraisal tools provided by the Joanne Briggs Institute [11-13].

Table 2 Characteristics of the study participants.

General patients included general/vascular/orthopaedic surgical patients, general medical /nephrology/endocrine patients. Veterans included 6 with peripheral artery disease (PAD). Number of individual GPs unknown from the practice numbers. Speciality unknown of general interns.

Table 3 Risk factors identified by members of the public and patients segregated into those correctly reported, those unrecognised and those incorrectly reported.

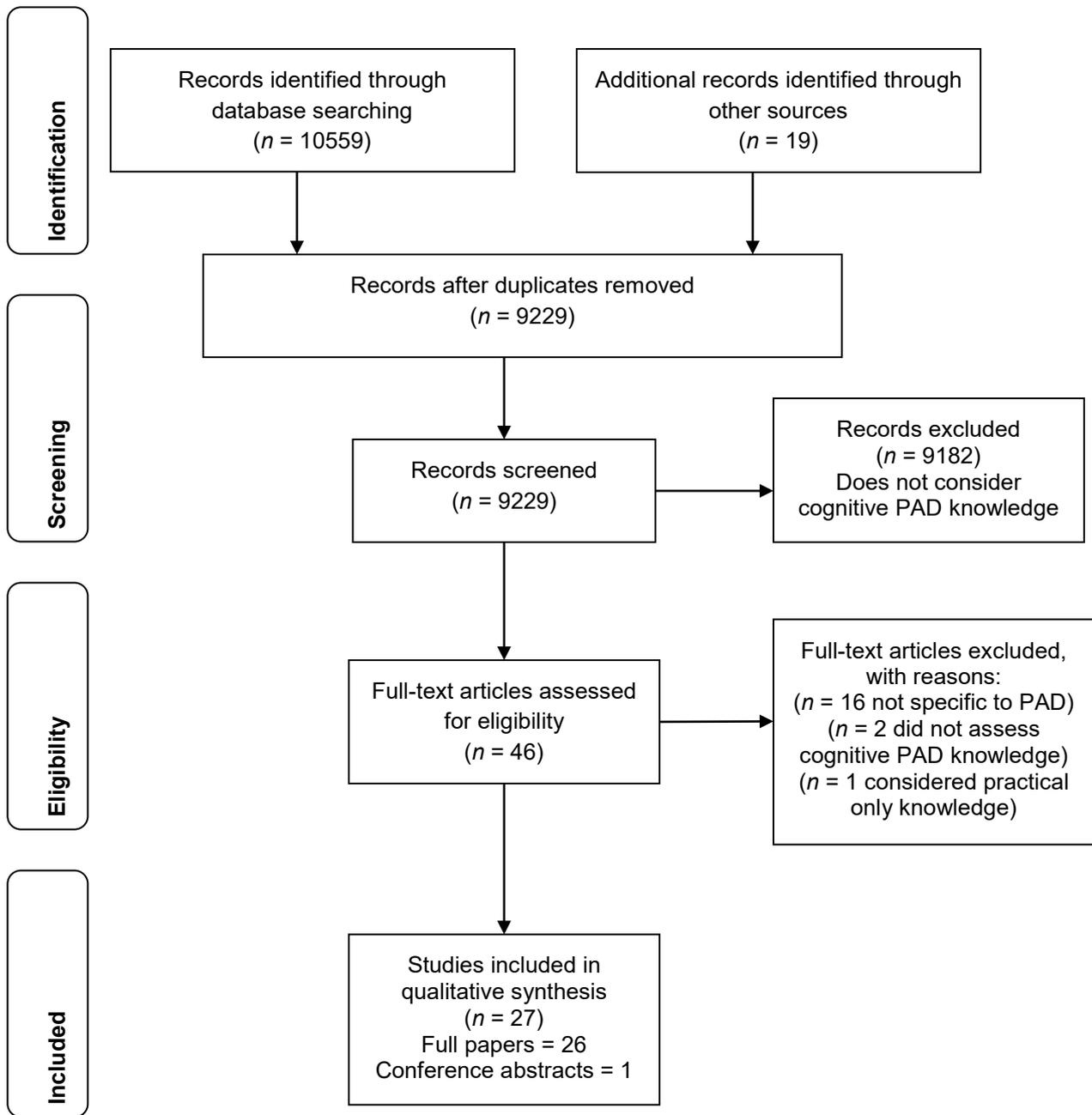


Figure 1

Table 1

Study overview (▼ interview □ survey ▣ questionnaire ◆ knowledge test )		Baseline characteristics			Study quality	Study Findings	Ref
Participants	Design	Population	Age (years)	Sex (%)	High ● Moderate ◎ Low ○	Knowledge Level	

Study overview (▼ interview □ survey ▣ questionnaire ◆ knowledge test)				Baseline characteristics			Study quality	Study Findings	Ref
Participants		Design	Population	Age (years)	Sex (%)		High ● Moderate ○ Low ○	Knowledge Level	
2019	AlHamzah	♂ 72	▼	Trainee nsHCP		F M	●	Suboptimal PAD knowledge in medical graduates	12
2018	Normahani	♂ 283	□	nsHCP	-	-	●	Lack of clarity of referral guidelines	31
	Stivalet	♂ 19	◆	Trainee nsHCP	-	-	●	No trainee knew how to completely perform an ABI	35
2017	Martineza	♂ 120	▣	Patients	Mean 72y	F M	○	Knowledge of PAD was 60.5% and less known about symptoms/medication	22
	Morr	♂ 237	□	Patients	-	F M	●	Improved PAD knowledge with education	24
2016	Wann-Hansson	♂ 21	▼	Patients	Mean 70y	F M	●	Uncertainty and varied PAD beliefs	26
	Chaudru	♂ 68	▣	Trainee nsHCP	-	-	○	Poor PAD knowledge and ABI technique	32
2015	Cronin	♂ 336	▼	Patients/public	-	F M	●	Lack of awareness of PAD	8
	Gorely	♂ 336	▼	Public	-	F M	●	General participant PAD knowledge	19
2013	Haigh	♂ 232	□	nsHCP	Median 50-59y	-	●	Lack of training, time, equipment and skills for PAD	30
2012	Chang	♂ 192	▣	Patients	Mean 65.7y	F M	●	Mixed knowledge and awareness	16
	Schwarz	♂ 58	▣	Trainee nsHCP	Mean 27.5y	F M	●	Poor knowledge with varied reported training	34
2010	Crisan	♂ 77	▼	Patients	Median 65y	F M	○	Knowledge of risk factors varied between 44.7 – 71.8%	18
	Godshall	♂ 151	□	Trainee nsHCP	-	-	○	No knowledge increase with knowledge only based education	36
2009	Zhuge	♂ 916	▣	Patients	-	F M	○	PAD knowledge depends on health insurance status	28
	Lovell	♂ 501	□	Public	Mean 64.4y	-	●	Largely unaware of PAD	20
	Tomczyk	♂ 20	▼	Patients	Mean 63.35y	F M	●	Gender differences in claudication description	25
2008	Aboyans	♂ 150	▣	Patients	-	-	○	Poor PAD and risk factor knowledge	13
	Bush	♂ 162	▣	Public	Mean 54.8y	F M	●	Low levels of PAD knowledge and awareness	15
2007	Coughlin	♂ 70	▣	Patients	Median 72y	F M	●	Risk factors awareness for PAD is suboptimal	17
	Hirsch	♂ 2501	□	Public	Mean 67.2y	F M	●	PAD knowledge was poor	21
	Muthu	♂ 52	▼	Patients	Median 75y	-	○	Specialist consultation improves PAD knowledge	23
2005	Batista	♂ 202	□	Patients	Mean 61y	F M	○	80% correctly responded regarding foot care	14
2004	Willigendael	♂ 1575	▣	Public/patient	Median >65y	F M	○	Low awareness of PAD symptoms/risk factors	27
2002	Treat - Jacobson	♂ 38	▼	Patients	Mean 65y	F M	●	83% patients with prior PAD knew their diagnosis	29
2001	Hirsch	♂ 6979	▣	nsHCP/Public	Mean 68.9y	F M	●	NSHCP PAD awareness is low	5

1994	Endean	50	◆	Trainee nsHCP	-	-	●	All groups performed poorly	33
------	--------	----	---	------------------	---	---	---	-----------------------------	----

Table 2

Members of the public	
General public	11959
Patients with PAD	612
Veterans (3.7% had PAD)	162
General patients	893
Non-specialist healthcare professionals	
General practitioners (GP)	232
GP practices	356
Podiatrist	283
Training nsHCP's	
Students	62
Vascular trainees	87
General trainees (speciality unknown)	58

Table 3

<b>Patient reported PAD risk factor</b>	<b>Unrecognised risk factors for PAD</b>	<b>Other perceived risk factors</b>	<b>Ref</b>
Smoking (86%)	Diabetes, cardiovascular disease, past history of PAD	Obesity, lack of exercise, Alcohol, Amputation	8
Hypercholesterolaemia (24%)	.		19
Hypertension (10%) Diabetes (83%)			
Increasing age (63.6%) Hypertension (66.2%) Tobacco use (59.7%) Atherosclerosis (51.%)			20
Smoking (39%) Hypercholesterolaemia (2%) Alcohol (23%) Hypertension (8%) Diabetes (2%)		Standing for long periods Cold baths	22
Cigarette smoking (44%) Diabetes (50%)	Hypertension Hypercholesterolaemia Cardiovascular disease	Obesity and lack of exercise	23
Smoking (81%)			25

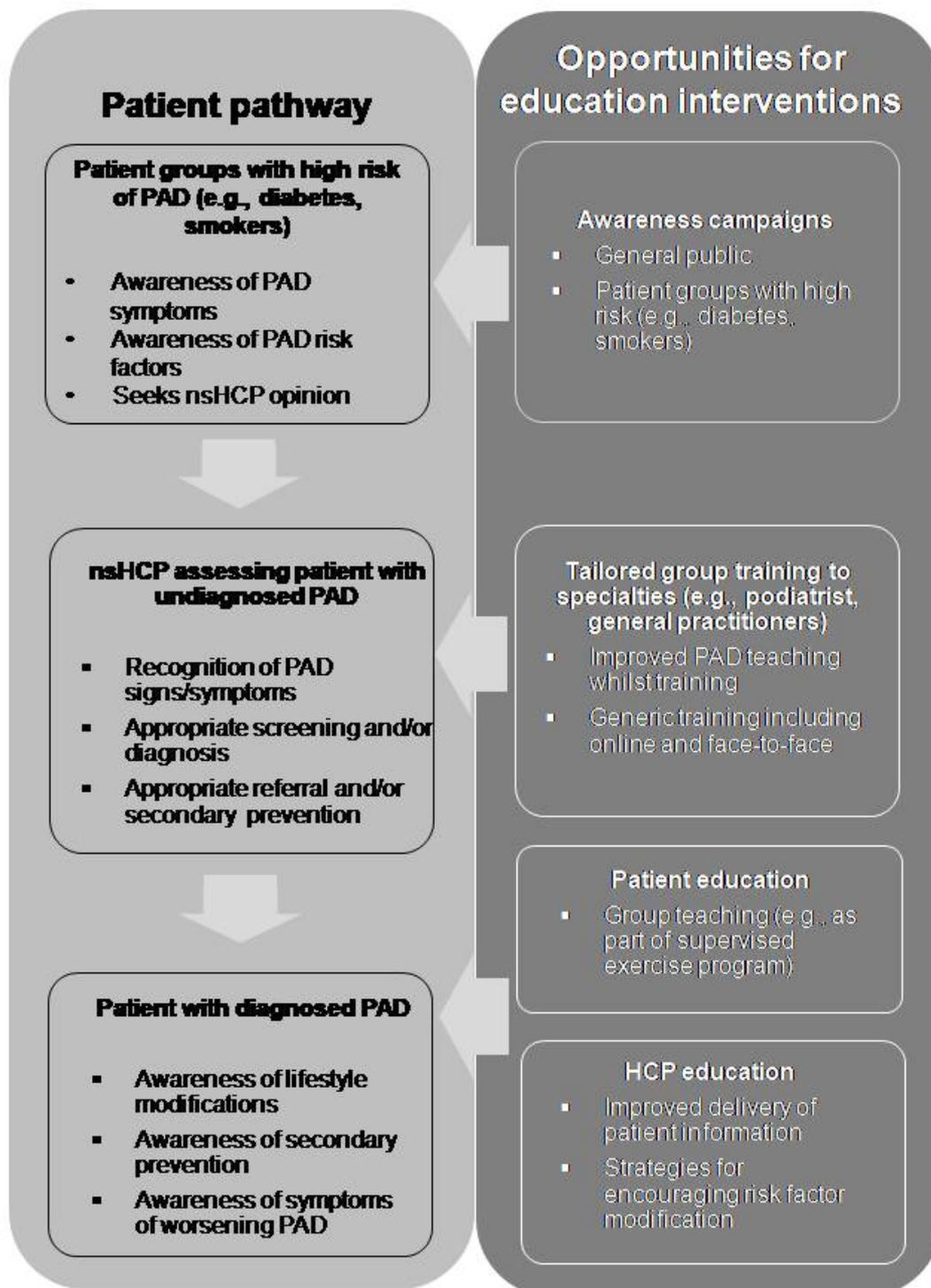


Figure 2