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ORIGINAL ARTICLE

Innovative Informatics Approaches for Peripheral Artery Disease: Current State and Provider Survey of Strategies for Improving Guideline-Based Care

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Abstract

Objective: To quantify compliance with guideline recommendations for secondary prevention in peripheral artery disease (PAD) using natural language processing (NLP) tools deployed to an electronic health record (EHR) and investigate provider opinions regarding clinical decision support (CDS) to promote improved implementation of these strategies.

Patients and Methods: Natural language processing was used for automated identification of moderate to severe PAD cases from narrative clinical notes of an EHR of patients seen in consultation from May 13, 2015, to July 27, 2015. Guideline-recommended strategies assessed within 6 months of PAD diagnosis included therapy with statins, antiplatelet agents, angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, and smoking abstention. Subsequently, a provider survey was used to assess provider knowledge regarding PAD clinical practice guidelines, comfort in recommending secondary prevention strategies, and potential role for CDS.

Results: Among 73 moderate to severe PAD cases identified by NLP, only 12 (16%) were on 4 guideline-recommended strategies. A total of 207 of 760 (27%) providers responded to the survey; of these 141 (68%) were generalists and 66 (32%) were specialists. Although 183 providers (88%) managed patients with PAD, 51 (25%) indicated they were uncomfortable doing so; 138 providers (67%) favored the development of a CDS system tailored for their practice and 146 (71%) agreed that an automated EHR-derived mortality risk score calculator for patients with PAD would be helpful.

Conclusion: Natural language processing tools can identify cases from EHRs to support quality metric studies. Findings of this pilot study demonstrate gaps in application of guideline-recommended strategies for secondary risk prevention for patients with moderate to severe PAD. Providers strongly support the development of CDS systems tailored to assist them in providing evidence-based care to patients with PAD at the point of care.

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Peripheral artery disease (PAD) is diagnosed in 1 of 20 Americans older than 50 years[1] and is an expanding global pandemic affecting more than 200 million individuals in developed and developing countries.[2,3] It increases the risk of mortality and often coexists with ischemic heart disease, the leading cause of death worldwide.[4,5] Accordingly, patients with PAD are at increased risk for myocardial infarction, angina, and stroke.[5]

Numerous studies have identified gaps in patient and provider knowledge of PAD, which likely contributes to the lack of adoption of evidence-based guideline recommendations in clinical practice.[6-8] The 2016 practice guidelines of the American College of Cardiology and the American Heart Association recommend that

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optimal secondary prevention therapy for patients with PAD include antiplatelet agents, statins, angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin II receptor blockers (ARBs), and smoking abstention.[9] However, patients typically receive only 1 or 2 of the 4 recommended therapies.[8,10] Many reasons likely contribute to the low adherence rates to guidelines including lack of provider knowledge and low provider comfort levels in treating patients with PAD.[7,10]

The emerging field of clinical informatics brings innovative approaches to investigate where discrepancies may exist between guideline recommendation and clinical care and may also provide solutions that mitigate gaps in practice. While some institutions have tried to implement information technology systems to address these issues, many have not been adopted or successful because of lack of provider input during creation, leading to dissatisfaction once implemented.[11,12] In the present study, we investigated the gap between optimal and actual treatment for patients with PAD and evaluated provider opinions regarding clinical decision support (CDS) for the implementation of secondary prevention strategies for patients with PAD.

PATIENTS AND METHODS

Automated Identification of PAD Cases Using Natural Language Processing

A previously validated natural language processing (NLP) algorithm was used to identify PAD patient cases from narrative clinical notes from the electronic health record (EHR).[13] The PAD-NLP algorithm used a knowledge-driven approach and consisted of 2 main components: text processing and patient classification. The text processing component was used to find PAD-related concepts in clinical notes using an open source clinical pipeline, MedTagger,[14] which analyzed text and identified PAD-related concepts. The PAD-related concepts were then mapped to specify categories used for patient classification. The NLP algorithm identified 73 patients with symptomatic PAD seen from May 13, 2015, to July 27, 2015, in Employee and Community Health, a community primary care practice in Rochester, Minnesota, which encompasses the divisions of primary care internal medicine, family medicine, and community pediatric and adolescent medicine. Employee and Community Health includes a main practice site and 4 additional clinic sites and provides care to approximately 152,000 patients residing in and around Olmsted County, Minnesota.

The performance of the PAD-NLP algorithm to identify PAD cases has been previously validated.[13] In this study, criterion standard manual abstraction criteria required a clinical diagnosis of symptomatic lower extremity PAD supported by ancillary diagnostic tests including ankle brachial index (ABI) value of 0.9 or less at rest or 1 minute after exercise,[9] presence of poorly compressible arteries based on ABI value of 1.40 or more,[9] prior limb revascularization or amputation due to ischemia, acute or critical limb ischemia, or evidence of flow limiting stenosis or occlusion of aortoiliac, femoropopliteal, or infrapopliteal arterial segments by computed tomography angiography, magnetic resonance angiography, or Duplex ultrasound.[9] For the study reported herein, patients with asymptomatic PAD with borderline ABI were excluded. The NLP algorithm for automated extraction of clinical characteristics also required the presence of key words describing PAD symptoms to classify a patient as a PAD case. Examples of key words and their lexical variants included claudication, leg (calf or calve) pain (discomfort, cramp), and ischemic ulcer.[13] The comprehensive list of key words and the rules applied in the NLP-PAD algorithm have been previously published.[13] For the present study, the performance of the PAD-NLP algorithm was also confirmed by manual abstraction of the EHR for all 73 cases.

Quality Indicators

Data collection included detailed review of the EHR of each patient. Characteristics of interest included age, sex, diabetes, hypertension, and smoking status (current smoker, ex-smoker, or not smoker). Medications used within 6 months of PAD diagnosis were recorded and included antiplatelet agents (aspirin or clopidogrel), statins, and ACEIs or ARBs. Patients known to be statin intolerant were included and counted as not following the statin guidelines. For each medication, both generic name and dosage were summarized. When available, the