



Phenotyping Algorithms for Identification of ASCVD Patients

Nakeya Dewaswala, M.D., Huzefa Bhopalwala, M.D., Alisha P. Chaudhry, B.A., Ronald A. Hankey, M.S., M.B.A., Rachit A. Kohli, Bruce M. Cameron, M.S., M.B.A., Christopher G. Scott M.S., Jane L. Shellum, M.H.A., Rick A. Nishimura, M.D., Rajeev Chaudhry, M.B.B.S., M.P.H., Adelaide M. Arruda-Olson, M.D., Ph.D.

Mayo Clinic, Rochester, United States of America

Objectives

To develop a clinical decision support (CDS) system to identify patients with atherosclerotic cardiovascular disease (ASCVD) and also promote use of secondary prevention strategies by physician and non-physician providers in underserved rural communities as a solution to mitigate current gaps in care for ASCVD utilizing an application entitled cohort knowledge solutions (CKS) that utilizes electronic health record (EHR) information linked to an institutional data warehouse.

Background

Adherence to expert guideline-recommended risk modification strategies including smoking cessation, antiplatelet agents, statin therapy, and blood pressure control significantly reduce adverse outcomes in patients with ASCVD.¹ Compliance with national guideline strategies also serves as a core metric for the Centers for Medicare and Medicaid Services. However, expert-endorsed risk modification strategies are underused by patients with ASCVD including those with peripheral artery disease (PAD), coronary artery disease (CAD), carotid stenosis, ischemic stroke/transient ischemic attack (TIA), and renal artery stenosis (RAS), especially in underserved rural communities.^{1,2} We have developed a CDS system to identify patients with ASCVD and also promote use of secondary prevention strategies by physician and non-physician providers in underserved rural communities utilizing an application entitled CKS that utilizes EHR information linked to an institutional data warehouse. The CDS system identifies patients with ASCVD and summarizes status of guideline-recommended therapies for each patient, as well as demographics, selected laboratory tests, and comorbidities. In this study we report development of the algorithms for identification of patients with ASCVD for use with this CDS system.

Methods

The ASCVD study cohort (n=32,837) was identified by ICD-10 and procedural code algorithms. Iterative refinement of phenotyping algorithms was conducted by comparison to gold standard manual review of random samples of 70 records of patients with each condition and repeated in separate samples in a second iterative round. After the first round of evaluation, codes not specific for ASCVD or which identified other disease processes were removed. For example, code I24.9 for acute ischemic heart disease non-specified and Z94.0 for status post kidney transplant were excluded from the final algorithms. For carotid stenosis and PAD, diagnostic codes were combined with procedural codes.

Results

Iterative removal of unspecified codes reduced false positives and inclusion of procedural codes increased true positives, thereby improving positive predictive value (PPV) in the second round of iterative evaluation. The PPV increased from 80% to 95% for CAD, 47.40% to 100% for carotid stenosis, 85.80% to 100% for PAD, 65.30% to 100% for ischemic stroke/TIA, and 79.40% to 100% for RAS. Results after the second round of iterative evaluation are summarized below (Table).

Discussion

The ASCVD CKS tool as developed thus far has proven to reduce provider burden, increase efficiency of provider's practice, and address the gap in guideline recommended care for these patients. Furthermore, through validation the ASCVD CKS tool has been proven to be accurate in identifying ASCVD patients allowing providers to access the pertinent information they need regarding ASCVD patients in one place instead of multiple, as currently seen in the EHR. In addition, the tool provides individualized information about ASCVD patients at the point of care.

Conclusions

We developed phenotyping algorithms based on billing codes for identification of ASCVD patients with very high PPV and specificity which will be integrated with clinical decision support systems for rural providers.

References

- Shelley D, Blechter B, Siman N, et al. Quality of cardiovascular care in small urban practice. *Ann Fam Med.* 2018;(Suppl 1): S21-S28.
- Yang Q, Cogswell ME, Flanders D. Trends in cardiovascular health metrics and associations with all-cause and CVD mortality among US adults. *JAMA.* 2012; 307(12):1273-1283.

Table: Results of iterative evaluation and refinement of phenotyping algorithms included in CDS system

ASCVD cohort (n=32,837)	Sensitivity	Specificity	PPV	NPV	F1 score
CAD	62.50%	100%	95%	40%	76.92%
Carotid stenosis	57.37%	100%	100%	25.71%	72.91%
PAD	63.63%	100%	100%	42.85%	77.77%
Ischemic stroke/TIA	71.40%	100%	100%	60%	83.30%
RAS	71.42%	100%	100%	60%	83.33%

Table Legend: CAD=Coronary artery disease, PAD=Peripheral arterial disease, TIA=Transient ischemic attack, RAS=Renal artery stenosis