Secondary ASCVD Risk Prediction using Electronic Health Record Data

Wyndy L. Wiitala, PhD; David P. Ratz, MS; Rodney A. Hayward, MD; Timothy P. Hofer, MD; Jennifer A. Burns, MHSA; Janelle Keusch, MPH; Stephanie Visnic, MS; Jeremy B. Sussman, MD

1VA Center for Clinical Management Research, VA Healthcare System, Ann Arbor, MI
2Department of Internal Medicine, University of Michigan Health System, Ann Arbor, MI

Background
- New, expensive drugs make predicting future secondary events of atherosclerotic cardiovascular disease (ASCVD) more important.
- The electronic health record (EHR) could make risk prediction more effective and practical.
- We evaluated whether the VA EHR can help predict ASCVD for secondary prevention and compared to a traditional risk score (the TIMI 2°Pr Model).

Risk Factors
- Traditional Risk Factors: Age, sex, diabetes diagnosis, hypertension diagnosis, hyperlipidemia diagnosis, statin use, BP medication use (0/1), smoking status
- Traditional risk factors, vital signs and labs: Blood pressure, total cholesterol/HDL ratio, LDL, atrial fibrillation
- ASCVD history: MI, stroke, PAD, CHF, CABG, PCI, peripheral arterial surgery
- Cardiovascular procedures: Type of prior procedure (bypass, stent, endarterectomy); location (peripheral, aortic, coronary, carotid); number of cardiac or neurological vessels intervened upon; number of procedures
- Less common risk factors: Atrial fibrillation, CKD and eGFR, heart rate
- Longitudinal variables: For blood pressure, heart rate, eGFR, and weight we will include longitudinal measures from the prior 5 years (e.g., mean, minimum, maximum, standard deviation, slope)
- Other comorbidities: ESRD, Serious Mental Illness, Substance Abuse
- Longitudinal changes: Time since last cardiovascular event
- Medication use: BP, cholesterol, anticoagulant, diabetes, antidepressant, antipsychotic, antianginal

Methods
- Data sources: VA CDW, Medicare, and National Death Index.
- Outcome: Fatal or nonfatal myocardial infarction or stroke over 5 years.
- Population: All VA ambulatory care patients aged 45-80 in 2009 who had a heart attack or stroke during the prior 5 years.
- Analysis: Prediction used elastic net regression with 5-fold cross-validation. Fit statistics were assessed with the testing dataset. Results of the VA Model were compared to the TIMI 2°Pr Model.

Conclusions
- The electronic health record can be used to predict secondary ASCVD events.
- We were able to identify patients with secondary event rates that varied widely, with 20-80th percentile 5-year event rates (18%-45% in men and 10%-36% in women).
- This technique can be calculated entirely within the electronic health record and could be used to stratify medicines for secondary prevention.

Results
- Population: 742,787 participants (726,588 Men and 16,199 Women)
  - 65% Men, 49% Women had prior MI
  - 47% Men, 61% Women had prior Stroke
- 30% Patients had a CV event during 5-year follow-up (30% Men; 24% Women).
- The VA EHR Risk Model had better discrimination and was better calibrated than the TIMI Model.

Results: Men
- Important risk factors: History of CHF, Afib, CABG, PAD, diabetes, medications, coronary endarterectomy counts.
- Compared to TIMI, the VA EHR model was slightly better calibrated and had better discrimination.
- The VA EHR had similar discrimination for subgroups (hx MI 0.68; hx Stroke 0.66).

Results: Women
- Important risk factors: History of MI, stroke, CHF, Afib, hypertension, number of prior carotid stents, other coronary procedures.
- Compared to TIMI, the VA EHR model was slightly better calibrated and had better discrimination.
- The VA EHR model had slightly worse discrimination for subgroups (hx MI 0.69; hx Stroke 0.70).