EHR phenotyping by Natural Language Processing improves detection of patients at risk for preeclampsia

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Background
The American College of Obstetrics and Gynecology (ACOG) and USPSTF recommend aspirin (ASA) to reduce the probability of developing preeclampsia. Identification of candidates for ASA prophylaxis is difficult due to the numerous risk factors documented in varying places in the Electronic Health Record (EHR). The aim of this study was to evaluate 3 detection strategies to identify patients for whom ASA was indicated: (1) clinician detection, (2) EHR phenotyping by discrete field evaluation and (3) EHR phenotyping by Natural Language Processing (NLP).

Methods
A retrospective cohort study of patients delivering from 10/1/2019 to 2/28/2020 for whom the complete prenatal record was available in the EHR. Patients meeting ACOG/USPSTF criteria for ASA prophylaxis were identified by chart audit. Based on manual chart review, patients recommended or who received ASA were coded as clinical detection. Discrete fields were queried for ICD-10 codes pertinent to the high and moderate risk factors. Finally, NLP using Bidirectional Encoder Representations from Transformers (BERT) in an automated machine learning environment was performed. Model choice was optimized for F1 score (a combination of precision and recall).

Results
Among 677 patients, 263 (38.8%) met criteria for ASA prophylaxis and 62 (23.6%) were recommended or received ASA; this served as the clinician detection rate. After application of EHR phenotyping via discrete fields, detection improved to 58.2% (153 received/263 indicated). Last, NLP using BERT yielded the highest detection rate (44 received / 60 indicated in the holdout cohort [73.3%]) while still maintaining discriminatory capacity (AUC-ROC 0.90) and a low false positive rate (12%).

Conclusion.
Compared to clinicians, detection of patients who meet criteria for ASA prophylaxis is doubled by implementation of EHR phenotyping based on discrete fields and increased threefold by addition of NLP. Using the criteria, machine learning and NLP can be used to detect patients at increased risk for preeclampsia and can be used to electronically track ASA use for this indication in the EMR, thereby decreasing reliance on labor-intensive, expensive chart audits.

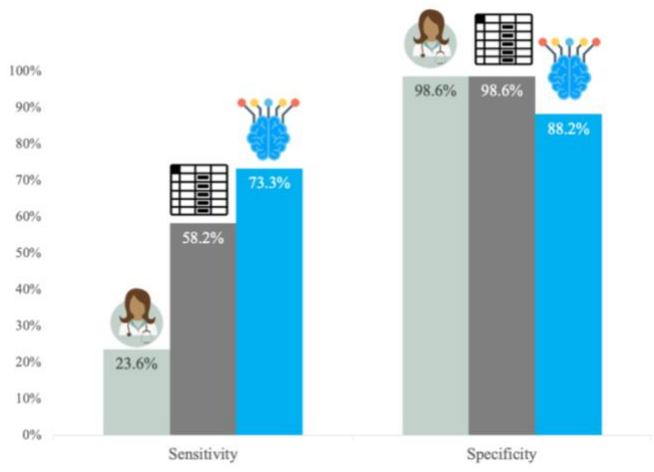

Figure 1: Performance of clinician detection vs EHR phenotyping for identifying candidates for aspirin prophylaxis.

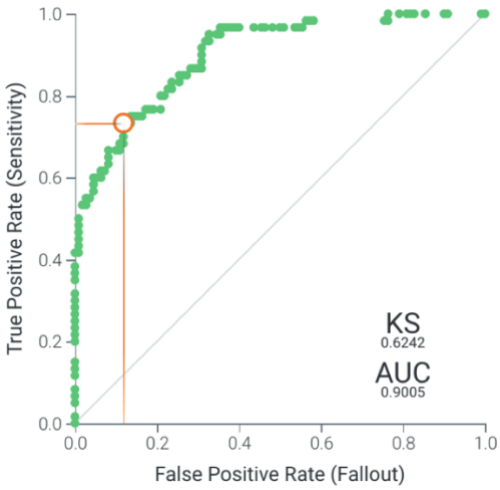

Figure 2: Receiver operating characteristic (ROC) curve for performance of BERT NLP in classifying patients for whom aspirin prophylaxis is indicated. ROC Area Under the Curve is 0.90.