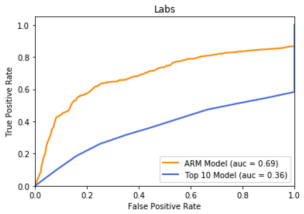
Associating Chief Complaints with Electronic Health Record Activity to Decrease Provider Administrative Burden

John Schrom, MPH, Vijan Joshi, MD, Colleen Bouey, Allison Gilmore, PhD
One Medical, San Francisco, CA

Introduction: Physician burnout has become a widespread issue, with electronic health record (EHR) use known to be a major predictor of burnout[1]. The burden of EHRs has become so problematic that patients are now reluctant to engage in medical encounters due to the overuse of technology in the exam room[2]. The average physician spends almost six hours per day interacting with their EHR[3]. Machine learning and data mining can decrease this administrative burden through smart shortcuts, based on predicted user behavior.

Methods: Clinical encounters were gathered from a large, national primary care clinic system. The chief complaint was parsed into UMLS concepts using QuickUMLS[4], a clinical named entity recognition tool. These concepts were combined with patient demographics and clinical activities during the encounter: lab orders, prescriptions, diagnoses, and referrals. The apriori algorithm was used to discover association rules between these concepts. Performance was evaluated on a holdout dataset by removing a random concept and looking for a discovered association above a varying confidence threshold between the remaining concepts and the removed one. A control model was created by identifying the Top N most common diagnoses, prescriptions, and labs, and was similarly evaluated by looking for a removed concept in a Top N list, with varying N. The impact on physician administrative burden was estimated by number of clicks in the EHR, using the sample's sensitivity and assuming one click reduction for medication and diagnosis, and two click reduction for lab orders.

Results: The dataset included 5,655,811 encounters, and association rule mining (ARM) discovered 3,019,661 rules. Many high-confidence rules involved direct correspondence of the chief complaint to the resultant activity (e.g., chief complaint of "bee sting" => new "bee sting" diagnosis). More nuanced associations — often symptom-based — also emerged (e.g., "broken condom" => STI testing; "motion sickness" => scopolamine prescription). Performance varied based on type of activity being predicted, with labs being the most performant (AUC = 0.69), followed by prescriptions (0.43) and diagnoses (0.41). The Top N models performed worse in all categories (see inset; labs: 0.36, prescriptions: 0.13, diagnoses: 0.14). We estimate this approach results in 3.2 fewer clicks per patient per year.



Discussion: This preliminary work demonstrates ARM as a method for identifying relationships between a patient's demographics and chief complaint, and their provider's EHR activity during the encounter. This approach performed better on lab ordering than medication prescribing or diagnosing. This may be due to larger number of classes being predicted, as well as more clinical variability in prescribing behavior and inconsistent diagnosis documentation. Even with its current performance, ARM is more predictive than a "Top 10 Most Common" style approach for the same activity. This suggests that implementing rules-based shortcuts in the EHR to allow single-click ordering, prescribing, and documenting would be more effective than listing the most common activity. Our approach would introduce opportunities to decrease clinical variation and improve documentation, while also saving the administrative burden of an estimated 4,800 clicks for a provider with a panel of 1,500 patients.

References

1. Shanafelt TD, Dyrbye LN, Sinsky C, et al. Relationship Between Clerical Burden and Characteristics of the Electronic Environment With Physician Burnout and Professional Satisfaction. Mayo Clinic Proceedings. 2016. 91(7): 836-848.
2. Street, RL, Liu, L, Farber, NJ, et al. Keystrokes, Mouse Clicks, and Gazing at the Computer: How Physician Interaction with the EHR Affects Patient Participation. J GEN INTERN MED. 2018. 33(4): 423-428
3. Arndt BG, Beasley JW, Watkinson MD, et al. Tethered to the EHR: Primary Care Physician Workload Assessment Using EHR Event Log Data and Time-Motion Observations. Ann Fam Med. 2017; 15(5): 419-426.
4. Soldaini, L, Goharian, N: Quickumls: a fast, unsupervised approach for medical concept extraction. In: SIGIR Medical Information Retrieval (MedIR) Workshop (2016)