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Machine Learning for Causal Inference via Pediatric Electronic Health Records in Epic Cosmos

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Abstract:
Observational analyses of pediatric electronic health record (EHR) data present unique challenges for researchers seeking causal inferences. Given the systematic exclusion of children, babies, and pregnant mothers from randomized trials, high-quality observational evidence is needed to inform effective treatment. Multiple sources of bias, paired with a large sample size, should make investigators wary of spuriously rejecting the null. We will discuss machine learning applications for causal inference in large EHR databases. Super Learner, an ensemble machine learning algorithm that combines parametric and nonparametric candidate algorithms, reduces the risk of model misspecification. Targeted maximum likelihood estimation reduces bias and yields an interpretable estimate with asymptotically valid confidence intervals. We will then present an application of this approach using Epic Cosmos, an EHR database of more than 300 million patients across the US. While sinusitis is one of the leading indications for pediatric antibiotics, and amoxicillin (AMX) and amoxicillin-clavulanate (AMC) are the two most commonly prescribed antibiotics for it, no randomized trial has directly compared these medications in children. We emulated a target trial to compare the effectiveness of AMX versus AMC for pediatric sinusitis. Finally, we will discuss next steps for this research using Epic Cosmos.

Suggested reading:

Hernán MA, Robins JM. Using big data to emulate a target trial when a randomized trial is not available. *Am J Epidemiol*. 2016;183(8):758-764. doi:10.1093/aje/kwv254. Free full text: https://pmc.ncbi.nlm.nih.gov/articles/PMC4832051/