Introduction to Target Trial Emulation Using Observational Data

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Abstract

Causal inference from observational data often faces skepticism. Critics, particularly proponents of trials, frequently argue that the absence of treatment randomization inevitably leads to confounding bias. This view is often reinforced when observational studies fail to replicate findings from randomized controlled trials (RCTs), with the discrepancies in results being attributed primarily to bias from unadjusted confounders. However, these critiques become more constructive when considering alternative explanations for the discrepancies, such as other sources of bias and differences in the research question to be answered (i.e., causal estimand). In this talk, I will provide a brief overview of a unified causal inference framework that has become increasingly popular in Epidemiology: the target trial emulation, where an observational study is designed by explicitly mimicking the elements of an ideal RCT that answers the question of interest. I will demonstrate that, while addressing confounding remains a critical component of observational causal inference, it is equally important yet underrecognized to minimize biases other than confounding and to align causal estimands.

Keywords— immortal time bias, collider, effect heterogeneity, time-varying treatment, negative control