Success Stories in Bayesian Adaptive Methods for Clinical Trials

Brad Carlin[1]

[1]*Division of Biostatistics, School of Public Health, University of Minnesota, Minneapolis*

Bayesian methods have a long history of success in clinical trial settings where patients and other resources are scarce, where good reliable external information is available, or both. In this talk we review several real-life settings where Bayesian methods have paid such dividends. First, we describe recent Bayesian advances in the adaptive incorporation of historical information in clinical trials through what are known as commensurate priors, showing connections with traditional meta-analytic methods and illustrating their potential for improved power while maintaining acceptable Type I error. We then extend these ideas to the adaptive randomization of patients in the trial. Here the idea is to randomize fewer patients to therapies from which strength may be borrowed from historical data, in order to preserve balance among the treatment groups. Next, we describe an adaptive Bayesian design for ensuring 95% survival of a medical device at 5 years, where interim posterior predictive distributions are used to decide whether to stop patient accrual. Further extension of this work again involves commensurate priors, through a comparison of a survival models version of this approach to a simple ad hoc procedure that employs differential weighting of historical and current data in a Kaplan-Meier estimate. Time permitting, we will mention still more recent examples of Bayesian adaptive successes in this area, including a novel Bayesian trial design that adaptively incorporates multi-trial historical information on the relationship between a surrogate and a clinical endpoint, discarding the surrogate and switching back to the original primary endpoint when indicated by the accumulating evidence. While like Nebraska's Platte River this talk will be "a mile wide and an inch deep," all of our success stories will be illustrated in the context of real trial settings arising in both academics and industry.

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