(Bayesian) meta-analysis: statistical methods and their applications in clinical medicine

A seminar by Tim Friede

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Thursday 18 Sep 2025 | 14:30-15:30

Room BENVENUTI

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Meta-analyses of clinical trials are a cornerstone of evidence-based medicine. In clinical medicine, often only a small number of studies, say 2 – 5, are available to address a specific research question. In these settings substantial uncertainty is attached to estimates of between-trial heterogeneity in treatment effects. However, standard methods fail to account for this uncertainty resulting in coverage probabilities well below the nominal level for confidence intervals of the overall treatment effect (Bender et al, 2018, Res Synth Methods). We start by reviewing frequentist approaches that account appropriately for this uncertainty by rescaling the standard error and use of t-quantiles rather than normal quantiles in the construction of the confidence intervals (Hartung and Knapp, 2001, Stat Med; Röver et al, 2015, BMC Med Research Methodol). As an alternative we consider Bayesian approaches to random-effects meta-analysis (Friede et al, 2017, Res Synth Methods) and consider practical aspects of their implementation including the choice of priors (Röver et al, 2021, Res Synth Methods; Röver et al, 2023, Stat Med) and the role of trace plots in their interpretation (Röver et al, 2024, Res Synth Methods). Finally, we discuss how predictive distributions and shrinkage estimators can be used to facilitate the integration of data from different sources such as a randomized controlled trial (RCT) and real world data (RWD) such as clinical registries (Röver & Friede, 2020, Stat Methods Med Res; Röver & Friede, 2025, Submitted).

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