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Reconstructing Individual Patient Level Survival Data from Aggregate Survival Data using a Simulation Approach

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Single topic, multi-speaker session, Workshop or Single presentation submission

A single presentation/poster

Single presentation or poster submission

The Guyot method is commonly used for reconstructing individual-level patient survival data (IPD) from digitised Kaplan-Meier curves. Although this performs well for reproducing survival curves, it may have limited performance for reproducing (or estimating if not reported) alternative summary measures to the hazard ratio (HR), especially when full information (risk table and total number of events) is unavailable. This limited performance is magnified when non-proportional hazards (NPH) are present. To estimate unreported summary measures with uncertainty, especially with crossing survival curves, a ‘simulation approach’ was developed for reconstructing IPD.

We simulate survival times from a log-cumulative hazards model with restricted cubic splines and censoring times using a piecewise exponential distribution. Uncertainty in the reconstruction process is obtained by producing multiple datasets from the data generating model. We average over the results to obtain a final point estimate for the target summary measure. This is compared with the Guyot method for estimating summary measures in the presence of NPH.

We demonstrate improved performance with respect to bias compared to the original IPD estimate for estimating alternative summary measures to survival probabilities such as the (average) HR and restricted mean survival time in the presence of NPH.

In the presence of NPH, reconstructing IPD using the Guyot method to obtain summary measures that are not reported may be inappropriate. Alternatively, a simulation approach is presented which demonstrates good performance for reproducing IPD and estimating summary measures with uncertainty. This can be extended for correlated endpoints such as PFS and OS.