Web Tool Development to Ease the Process of Performing the Meta-Analysis of Kaplan-Meier Curves Published in Various Studies

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Conclusion

In conclusion, our mission to create a user-friendly web-based framework for the 'metaSurvival' package has been achieved. By deploying it in the open-source domain, we've paved the way for seamless accessibility. Researchers can now harness the power of 'metaSurvival' with ease, opening new avenues for advanced survival analysis. This marks a significant step towards democratizing robust analytical tools and fostering collaborative research endeavors.

Background

- The domain of statistical techniques for meta-analysis in survival studies has primarily centered on pooling studies that compare two arms with a primary focus on evaluating a collective measure of the intervention's impact
- In recognizing this limitation, there is a growing awareness that pooled survival probabilities for each arm can offer valuable complementary information to better understand the variation of the intervention's effect
- Furthermore, the epidemiological studies often involves the assessment of the risk of time-dependent outcomes in specific populations and there is a need for methods that go beyond conventional metrics and offer an understanding of the survival curves in a single population. Hence, enhance the comprehensiveness of meta-analytical approaches

Objective

- The goal is to create a web-based framework for the "metaSurvival" R package, ensuring easy access and user-friendliness within the open-source domain
- The initiative aims to enhance the utility of the package, particularly for researchers who may not have extensive coding or statistical software expertise

Methodology

- A web application was developed in R using the R-Shiny package, adapting and modifying functions from the "metaSurvival" package to suit this platform
- The application is initially loaded with default data, but users can upload custom data in a specified format to conduct their own analyses
- The deployment of the tool took place via a Docker container on Amazon Web Services (AWS), fortified with Secure Sockets Layer (SSL) certificates.
- User authentication was managed by Auth0. Notably, any data uploaded during an active session is transient, existing only for that duration and not persisting on any server
- Several methods have been suggested to derive a summary survival curve from published survival data. The simplest involves pooling survival probabilities reported at the same time points, either through fixed effect univariate methods or random effects. Heterogeneity impact is measured using statistics like I-squared and H-squared
- The summary probabilities are obtained by multiplying the pooled estimates, eliminating the need for assumptions about the survival curve's shape

Figure 1: Pooled Kaplan-meier plot (fixed-effect)

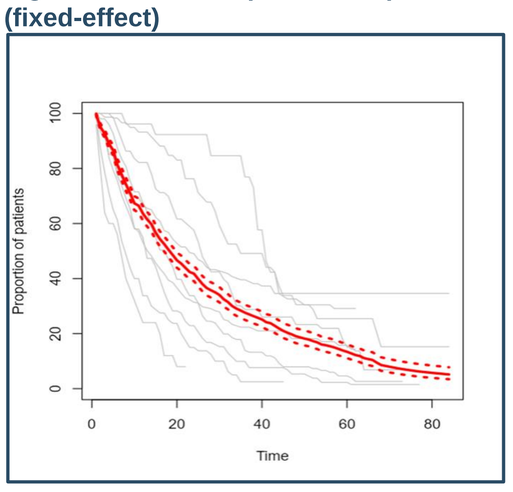
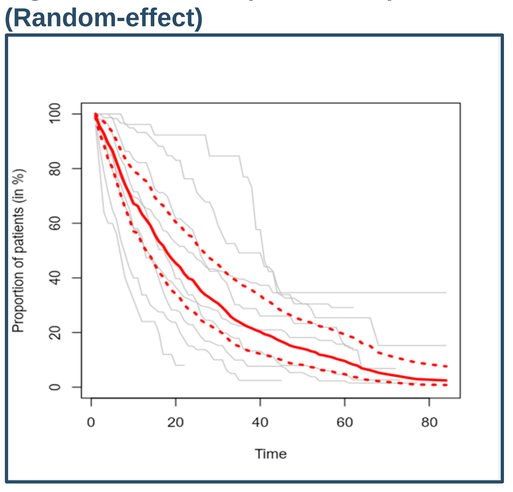


Figure 2: Pooled Kaplan-meier plot (Random-effect)



Results

- This web-based tool, accessible at https://metasurvival.survlytics.com/, has been deployed as an open-source platform. It allows for the execution of multiple sensitivity analyses by excluding specific studies from the meta-analysis
- The tool provides outputs such as heterogeneity testing, median survival, restricted mean survival, and pooled survival probabilities. Both fixed and random effect models are incorporated into the results
- The results also explore the goodness-of-fit statistic, Heterogeneity-Q, describes the variability among the studies in the analysis. The H-squared and I-squared values further indicate the degree of heterogeneity. These metrics are essential for understanding how well the studies align and contribute to the overall findings
- Users can easily download all analysis outputs in Excel and various formats for seamless reporting

Table 1: Pooled tabular results (fixed-effect)

Time	Pooled survival probability	Lower bound	Upper bound
1	0.995916	0.992625	0.999217
2	0.95106	0.939721	0.962534
3	0.926198	0.912492	0.94011
4	0.890477	0.874078	0.907184
5	0.8666	0.848744	0.884832
6	0.813093	0.792484	0.834237
7	0.778271	0.756292	0.80089
8	0.742486	0.719325	0.766392
9	0.709693	0.685628	0.734603
10	0.673236	0.648316	0.699114
11	0.664904	0.639831	0.69096

Table 2: Pooled tabular results (Random-effect)

Time	Pooled survival probability	Lower bound	Upper bound
1	0.994152	0.987763	1
2	0.954767	0.927799	0.982518
3	0.928288	0.887197	0.971281
4	0.89193	0.8344	0.953427
5	0.866411	0.803382	0.934385
6	0.823601	0.752135	0.901857
7	0.781133	0.703305	0.867573
8	0.741637	0.656532	0.837775
9	0.709095	0.617747	0.81395
10	0.671964	0.570679	0.791226
11	0.663324	0.563189	0.781263

References

Combescure C, Foucher Y, Jackson D. Meta-analysis of single-arm survival studies: a distribution-free approach for estimating summary survival curves with random effects. Stat Med. 2014 Jul 10;33(15):2521-37. doi: 10.1002/sim.6111. Epub 2014 Feb 13. PMID: 24532219.

Disclosure

SP, PB, BS and AS the authors, declare that they have no conflict of interest

Presented at ISPOR • ISPOR Europe | Copenhagen, Denmark | November 12–15, 2023

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