Parameterize State-Transition Models in Oncology Using Published Survival Curves and Bayesian Calibration: A Web-Based Application

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Why is this app needed?

- Most oncology clinical trials do not make IPD accessible, limiting the ability to accurately estimate transitions between health states in decision models.
- Partitioned survival models (PSM) are widely used to model and extrapolate OS/PFS curves when IPD is not available, however their assumptions are heavily criticized.
- We developed a calibration framework to estimate key parameters for STMs incorporating 3 health states (PF, P, D) using R.
- **Here we introduce a web-based tool, based on R Shiny, to execute this calibration framework without requiring any coding skills.**

Process overview

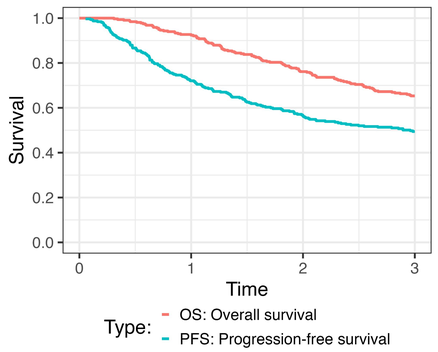

Figure 1. Digitize survival curves and reconstruct individual patient data (IPD) to define calibration targets.

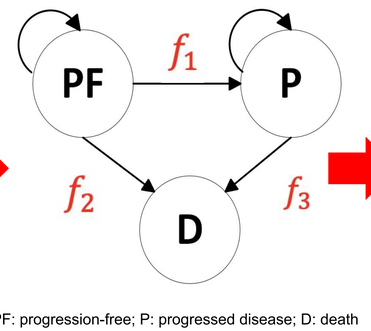

Figure 2. Calibrate transition-related parameters using a state-transition model (STM) and the Incremental Mixture Importance (IMIS) algorithm.

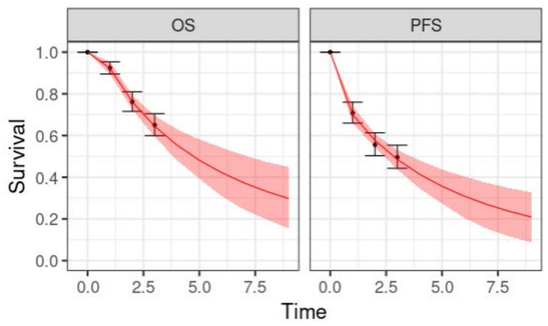

Figure 3. Use calibrated parameters to fit a 3-state STM (and extrapolate!)

Access our application!

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Case use example using our App

Steps to use the App

1. Digitize OS and PFS curves.
2. Define calibration targets.
3. Select parametric distributions to describe the time-dependent transitions in a 3-state STM.
4. Employ Bayesian calibration (IMIS algorithm) to estimate the transition-related parameters.
5. Check convergence of the calibration process.
6. Compare calibration results against targets and download calibrated posterior parameter sets.
7. Extrapolate!

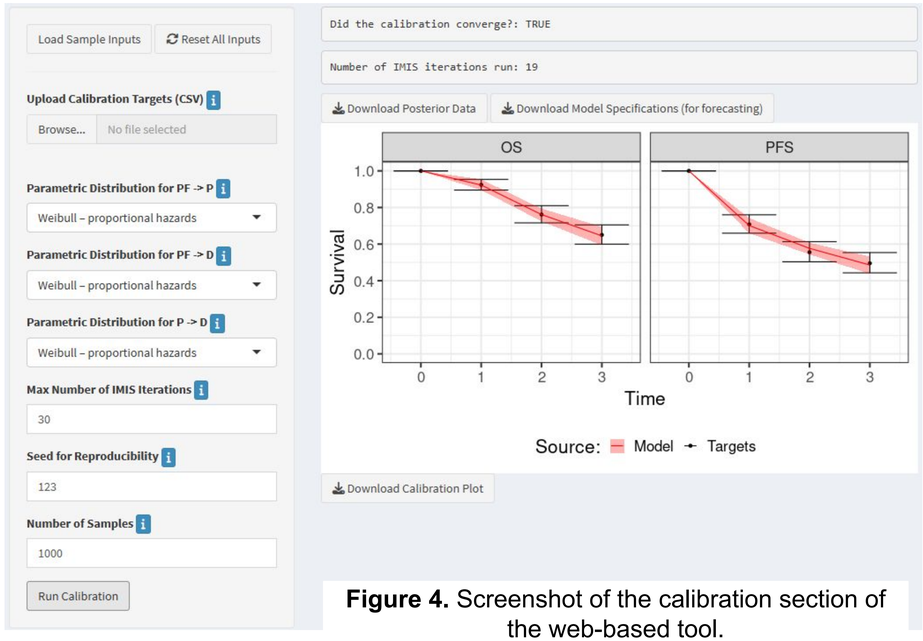
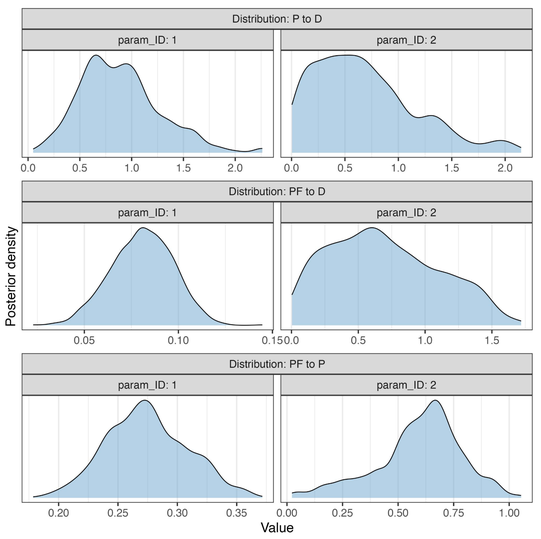


Figure 4. Screenshot of the calibration section of the web-based tool.



PF: progression-free; P: progressed disease; D: death

Figure 5. Density plots of calibrated posterior parameter sets.

Takeaways

- We developed a Bayesian calibration framework to estimate key parameters for 3-state STMs from OS/PFS curves.
- This approach offers a more accurate and transparent alternative to PSM, since transitions probabilities between health states can be estimated and extrapolated.
- All steps are performed within the online app, from digitizing curves to parameter estimation and model extrapolation.
- With this app, users can obtain calibrated parameter sets for use in their decision models.