

Additional file 3. Bootstrap internal validation and clinical impact

Bootstrap internal validation summary

- Apparent C-statistic: 0.965
- Mean optimism (AUC): 0.021
- Optimism-corrected C-statistic: 0.944
- Apparent calibration slope (bootstrap resampling): 1.255
- Optimism-corrected calibration slope: 0.860
- Successful bootstrap resamples: 1,000/1,000

Note: The in-sample calibration slope from the primary calibration plot reported in the main manuscript was 0.971. The bootstrap apparent slope above reflects resampling-based estimates from enhanced internal validation.

Clinical impact at selected thresholds

At threshold probabilities of 10%, 30%, and 50%, the model classified 202, 161, and 140 patients as high risk, with true-positive counts of 142, 134, and 128, respectively (positive predictive values 70.3%, 83.2%, and 91.4%).