Calibration of a discrete event simulation model to support the implementation of AI in breast cancer surveillance

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OBJECTIVE

To calibrate a developed model simulating the clinical and health economic impact of different implementation scenarios of artificial intelligence in breast cancer surveillance strategies

CONCLUSION

The predictions of the calibrated model align closely with the expected outcomes. The model is ready to support healthcare providers and developers regarding decisions on AI implementation through quantifying health and monetary benefits for breast cancer surveillance

METHODS

Discrete Event Simulation

- Clinical pathway of breast cancer surveillance
- Underlying disease model for locoregional recurrence (LRR) and distant metastases (DM)
- To match the expected incidence numbers of LRR (3%) and DM (6.3%)

Calibration of parameters

Survival after DM for oligo (≤3 DM) and non-oligo (>3 DM) metastatic disease (1

Tumour Volume Doubling Time (VDT) (2

Annual risks of LRR and DM after sensitivity analysis for VDT and DT (3 (4

RESULTS

SURVIVAL AFTER DM

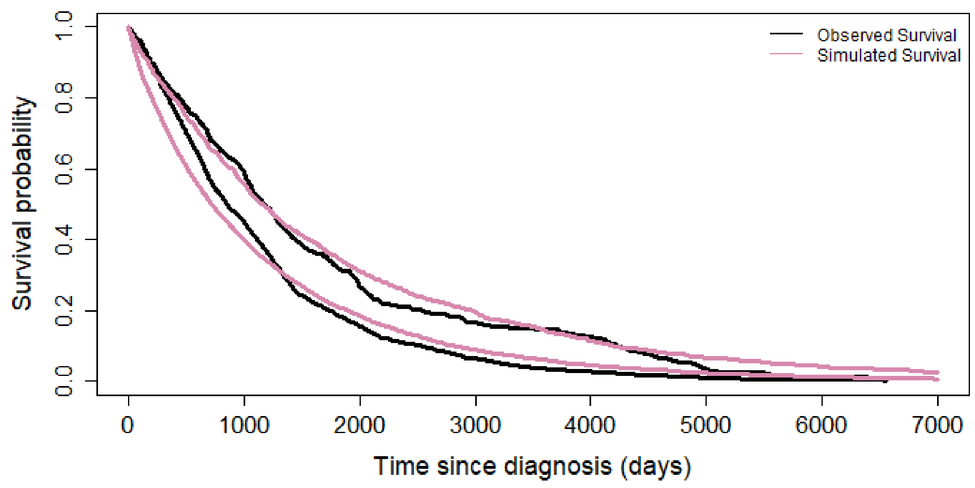

Figure 1. Observed (black) and simulated (pink) survival for patient with oligo (≤3 DM) and non-oligo (>3 DM) metastatic disease. Patients with oligo metastatic disease showed better survival. Kolmorogov-Smirnov tests indicated no significant difference.

DISEASE MODEL - VDT

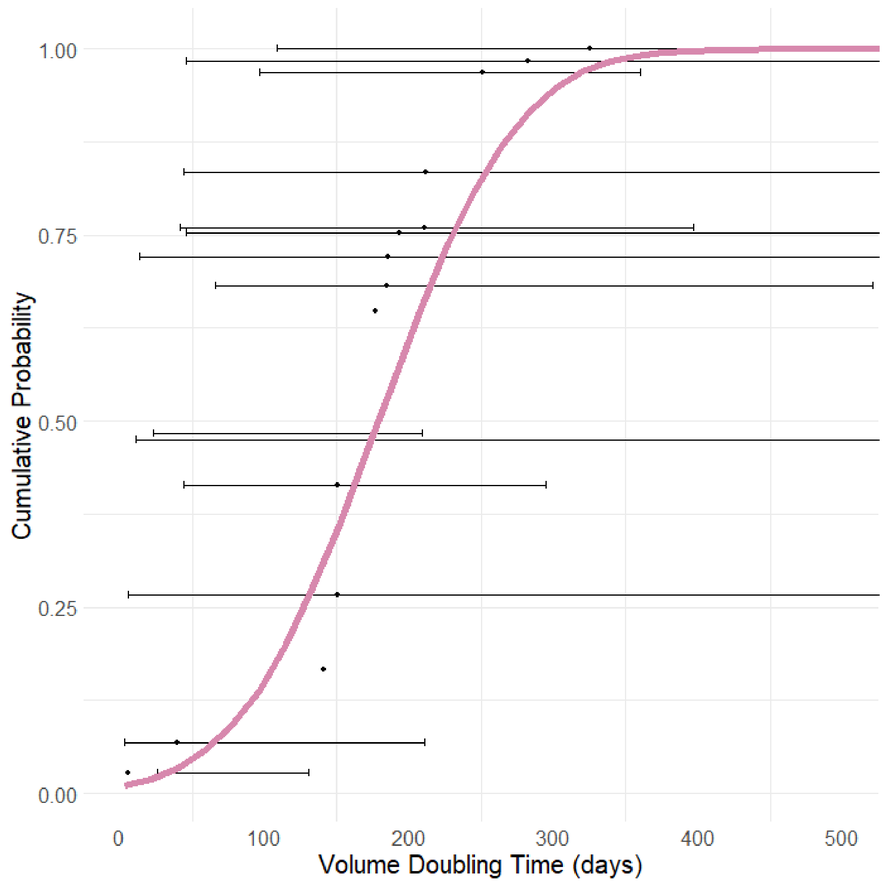

Figure 2. Fitted cumulative distribution function of tumour volume doubling time. VDT values were obtained from reported VDTs of primary breast cancers. A cumulative normal distribution using a maximum likelihood estimation was fitted to the reported data.

ANNUAL RISK

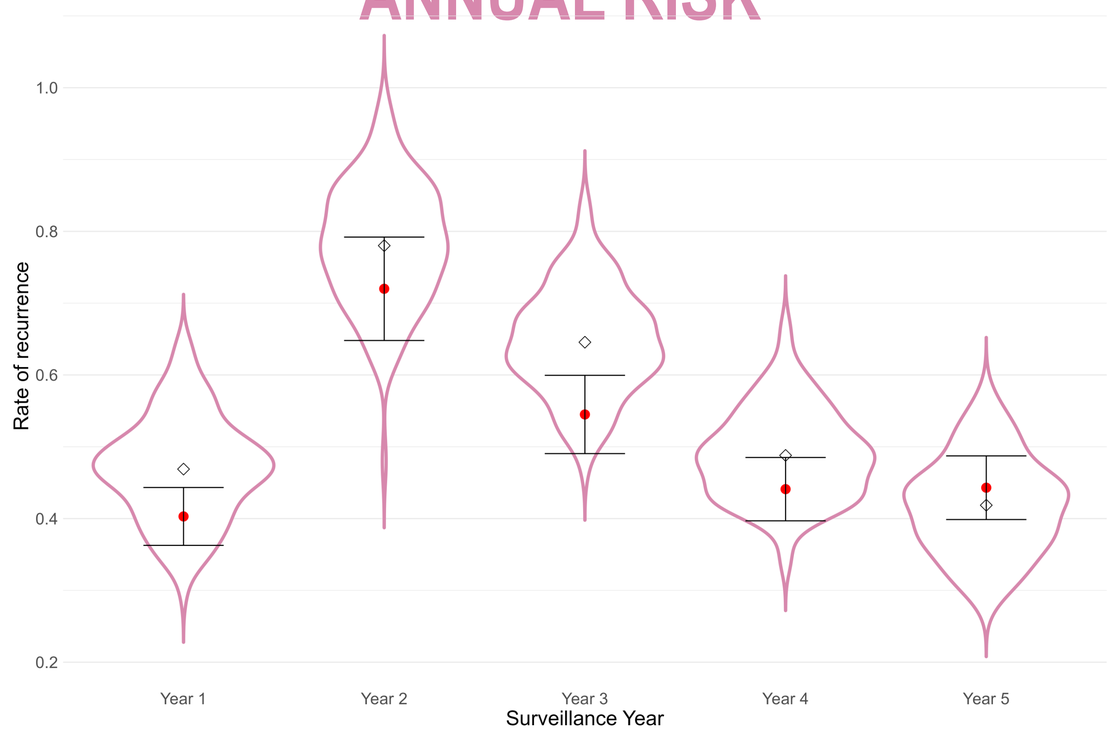

Figure 3. Sensitivity analysis of the VDT. VDT was sampled from a multivariate normal distribution using the estimated coefficients and variance-covariance matrix obtained from the maximum likelihood estimation. The violins show the density and uncertainty of incidence of LRR in 100 simulations with 10.000 simulated, compared to the expected values (in red). Mean incidence was 280 recurrences (2.8%).

Figure 4. Sensitivity analysis of the detection threshold (DT). DT was randomly varied from a normal distribution around 5mm tumour diameter with SD of 1mm. The violins show the density and uncertainty of incidence of LRR in 100 simulations with 10.000 simulated, compared to the expected values (in red). Mean incidence was 284 recurrences (2.8%).

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