A New Tumor Dynamics Mathematical Model
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Objective: To propose a new mathematical model to capture tumor dynamics in clinical treatment data.

Methods: During analysis of clinical data from cancer patients receiving various treatments, the need for a different tumor dynamics model arose—in particular, one that allows a nonzero horizontal asymptote and does not have unbounded long-term growth. The model proposed here satisfies these requirements and was able to fit clinical data from a variety of oncology therapy studies. The model was compared with certain historical models, including some from [1], [2], and [3], using the FOCE-ELS algorithm in Phoenix NLME version 6.4.0.768 (Certara USA, Inc.). Several data sets were used in order to include multiple indications and therapies.

The new model allows for tumor sizes that first increase then decrease, first decrease then increase, or change only monotonically. The figure below shows example model curves that exhibit each of these behaviors.

Results: In a number of goodness-of-fit measures, including diagnostic plots and the Bayesian information criterion, the new model (without covariates) performed better than several historical models considered (also without covariates). These results held across indications and therapies.

Conclusions: The new model proposed here fit certain clinical data sets better than several historical models and may provide advantages in future modeling and simulation of tumor dynamics.

References: