FractaLPK

# Tumor Auto-Diagnose Report

Dataset **LLC murine carcinoma (Hahnfeldt/Benzekry cohort)** · Generated 2026-05-26 10:21 UTC · ID 1c9ae33732

**Quality assessment: Review recommended**

This report summarises the tumor growth analysis of LLC murine carcinoma (Hahnfeldt/Benzekry cohort), comprising 20 subjects and 173 observations. 5 structural models were evaluated; the Logistic model was selected based on AIC ranking (ΔAIC = 9.90 vs runner-up). Model converged with adequate precision. Growth dynamics are best described by the Logistic structure.

VERDICT

**SATURATING GROWTH — Best model: [Logistic]. Tumor approaches a plateau characteristic of carrying-capacity-limited growth; angiogenic balance is not separately required to explain the trajectory. ΔAIC = 9.90 vs the next candidate.**

**Selected model:** Logistic ($R^2$ = 0.992, AIC = -60.52)

| ΔAIC vs runner-up | $R^2$ | Confidence |
|---|---|---|
| 9.90 | 0.992 | high |

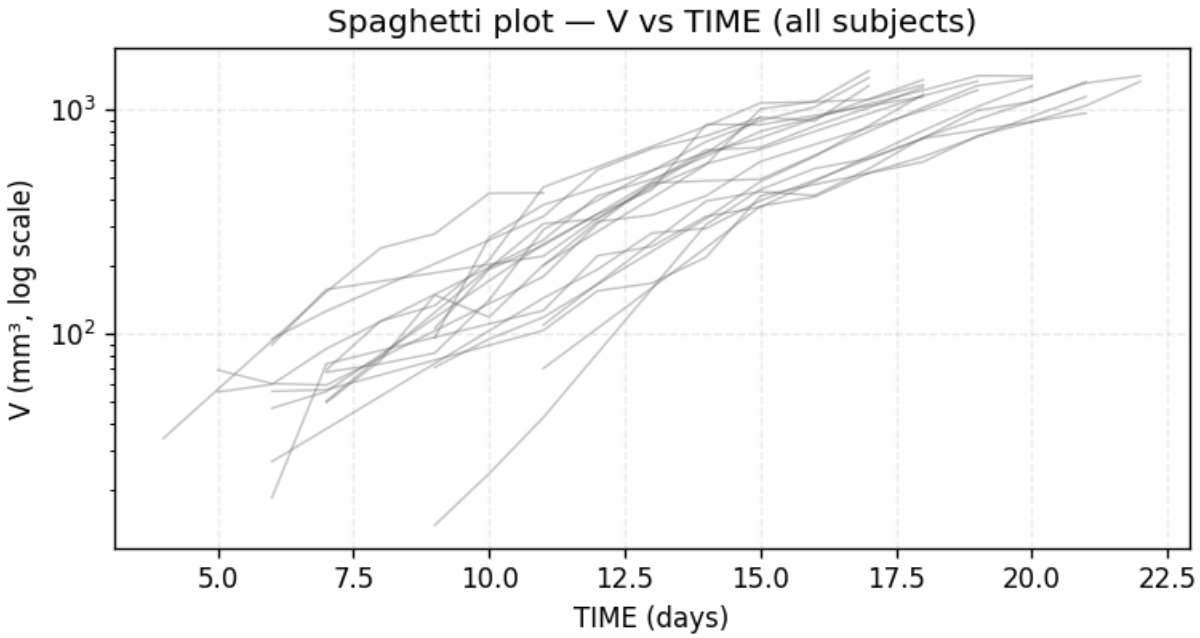
Rule applied: **RULE 5 SATURATING**

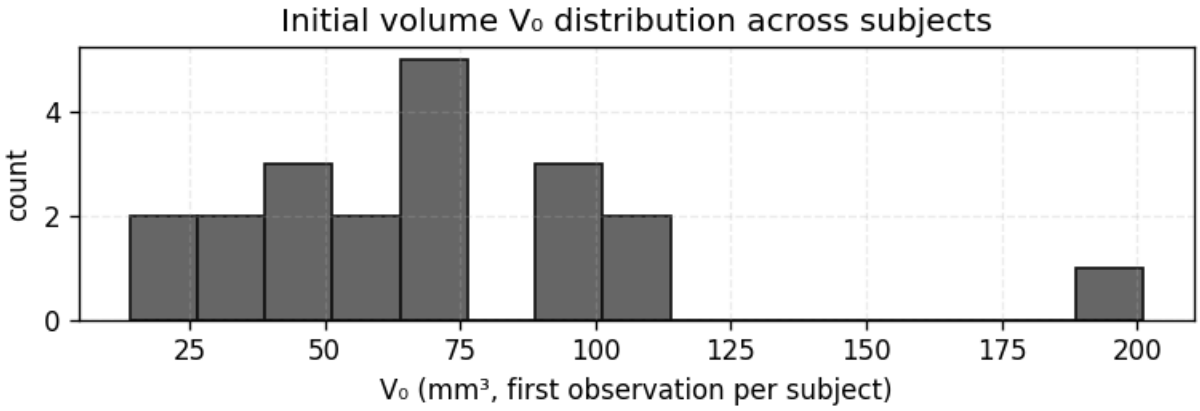
## Key parameters

| Parameter | Estimate |
|---|---|
| V0 | 10.99 |
| K | 1707 |
| r | 0.2973 |

# Dataset overview

| | |
|---|---|
| Subjects (N) | 20 |
| Observations | 173 |
| TIME range (days) | 4.0 – 22.0 |
| V range (mm³) | 14.0 – 1492.1 |



# Model comparison — 5 structural variants

| # | Model | Class | n | OFV | AIC | ΔAIC | R² | Conv |
|---|---|---|---|---|---|---|---|---|
| **1 ★** | **Logistic** | **logistic** | **3** | **-66.52** | **-60.52** | **ref** | **0.992** | ✓ |
| 2 | Gompertz | gompertz | 3 | -56.62 | -50.62 | +9.90 | 0.986 | ✓ |
| 3 | Exponential | exponential | 2 | -36.63 | -32.63 | +27.89 | 0.961 | ✓ |
| 4 | Hahnfeldt classical | hahnfeldt_classical | 2 | -36.30 | -32.30 | +28.22 | 0.960 | ✓ |
| 5 | Hahnfeldt fractional | hahnfeldt_fractional | 3 | -37.66 | -31.66 | +28.87 | 0.963 | ✓ |

## Verdict — rule applied

Rule 5 — Gompertz or Logistic wins by ΔAIC ≥ 4. Tumor approaches a plateau characteristic of carrying-capacity-limited growth.

# Selected model — parameter estimates

**Logistic** · logistic · 3 free parameters

### *THETA — population estimates*

| Parameter | Estimate | %RSE |
|---|---|---|
| V0 | 10.99 | N/A |
| K | 1707 | N/A |
| r | 0.2973 | N/A |

### *Derived quantities*

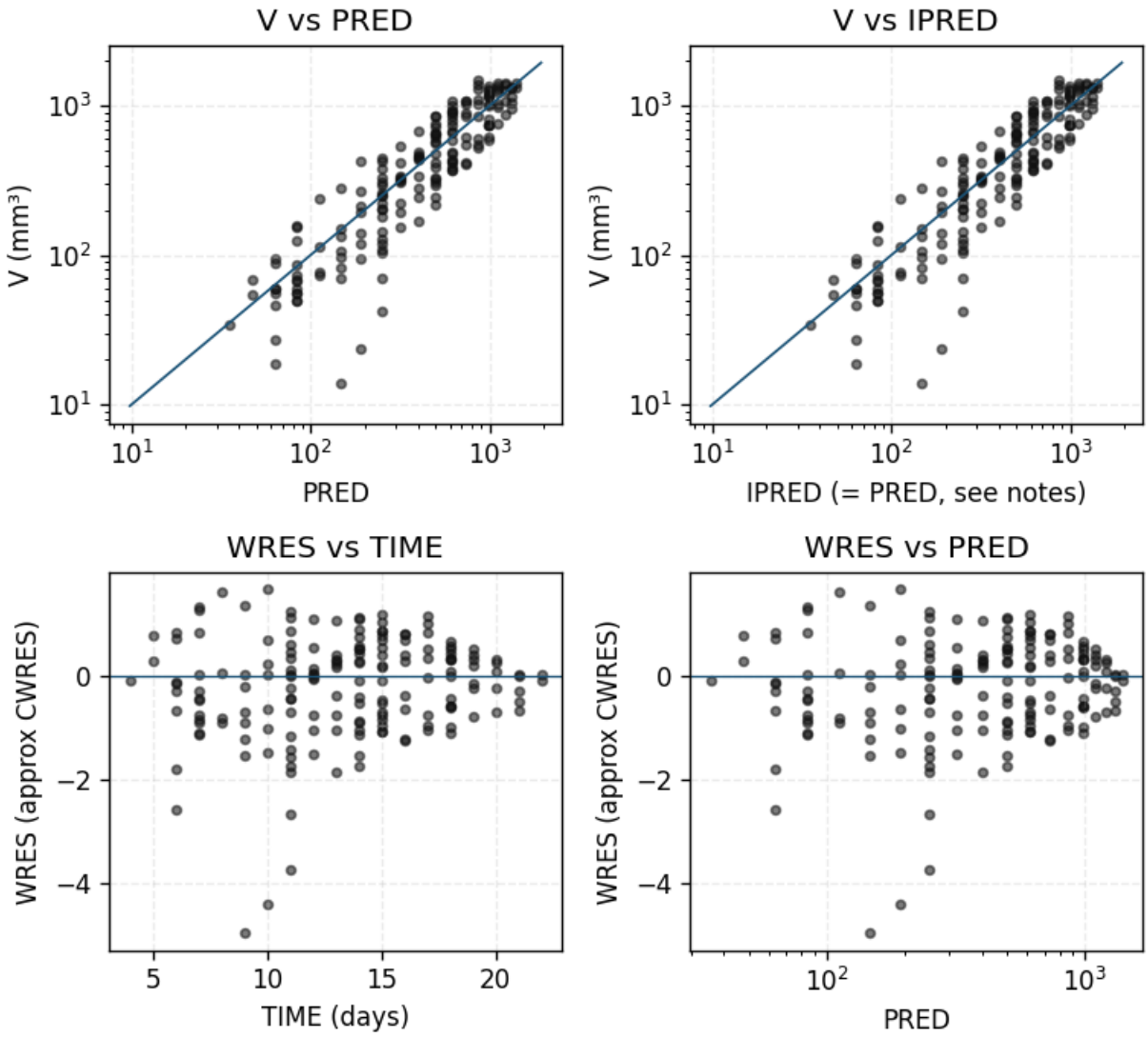
| Quantity | Value | Units | Formula |
|---|---|---|---|
| Doubling time (initial) | 2.33 | days | ln(2) / r |
| Time to 50% of K | 17 | days | ln((K–V0)/V0) / r |
| Time to 90% of K | 24.3 | days | ln(9·(K–V0)/V0) / r |
| V(t_max)/K (t_max=22 d) | 81.8 | % | logistic at t_max |
| Carrying capacity K | 1.71e+03 | mm³ | fitted |

Computed from fitted parameters. Numerical values only; pharmacological interpretation is the responsibility of the user's clinical/formulation team.

### *Variability & residual error*

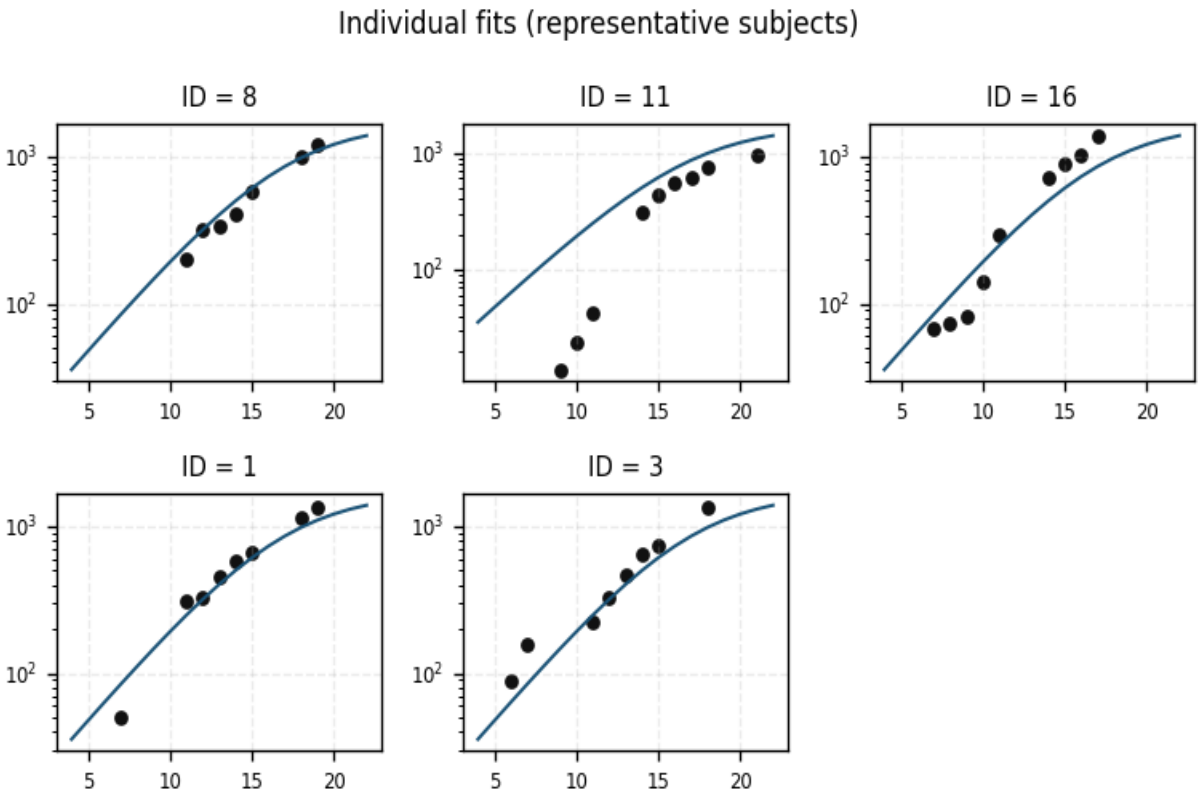
Population-level estimates. Individual-subject variance components (OMEGA / shrinkage) are part of the extended analysis tier.

# Goodness-of-fit



# Individual fits

Representative subjects (best-fit, worst-fit, median, plus spread): 8, 11, 16, 1, 3



# Diagnostics & methodological notes

| Metric | Value |
|---|---|
| Winner iterations | 433 |
| Winner wall time (s) | 0.25 |
| Winner converged | yes |
| Total wall time (s) | 275.7 |
| Engine | tumor_fitter (Fase A.1, simplified Hahnfeldt-Can) |
| λ nominal (1/day) | 0.192 |
| b nominal (1/day) | 5.85 |
| N observations (mean curve) | 19 |
| t range (days) | 4.0-22.0 |

## Methodological notes

Tumor-vasculature dynamics are modeled using a simplified Hahnfeldt-type system (Can 2026) without the V^(2/3) inhibitor term of the original Hahnfeldt et al. 1999 formulation. Angiogenic rates λ=0.192/day and b=5.85/day are derived from Hahnfeldt 1999 LLC reference values; the inhibition rate d=0.30/day is calibrated for plateau dynamics in the simplified system.

Primary verdict criterion: ΔAIC ≥ 4 against the next-best model. The regime-detection layer raises this to ΔAIC ≥ 8 only for Hahnfeldt fractional in short exponential-only observation windows.

The verdict logic includes a regime-detection layer: when the observation window is shorter than the calibrated Hahnfeldt-Can range, Hahnfeldt fractional verdicts require stronger statistical evidence (ΔAIC ≥ 8) to override simpler models. This protects against overfitting in short exponential-only windows.

Fractional order α is estimated from the data with synthetic validation accuracy ±0.10; clinical/biological interpretation of α is the responsibility of the user's expert team.

When does the fractional model win? In our internal benchmarks, Hahnfeldt fractional tends to outperform the classical alternatives when the observation window captures (a) a clear inflection between exponential growth and plateau saturation, AND (b) heterogeneous growth dynamics across subjects (large variance in late-window slopes). It does NOT win — and should not be expected to win — when the data are exponential-only (rule 6 territory), when saturation is clean and single-rate (Gompertz / Logistic typically suffice via rule 5), or when noise dominates the signal (rule 1 territory). A non-fractional verdict is therefore a feature, not a failure: it indicates that the underlying dynamics do not require fractional kinetics to be explained, and reporting the simpler model preserves parsimony.

### *Limitations*

Current scope: Tumor growth dynamics only. Drug-effect terms (immunotherapy, chemotherapy, anti-angiogenic) are outside the scope of this report; the underlying solver supports treatment schedules (u1, u2) but datasets here are restricted to control arms. Estimates are at the population level; individual-subject variance components are part of the extended analysis tier.

### *Disclaimer (extended)*

This report contains computational results. Pharmacological interpretation and clinical decisions are the responsibility of the client's expert team. FractaLPK does not provide medical, pharmacological, or regulatory advice. Models compared by AIC; statistical equivalence threshold ΔAIC ≥ 4 (raised to ≥ 8 for Hahnfeldt fractional in short exponential-only windows). Verdict is a diagnostic indication, not a regulatory conclusion.

# Your analysis is complete.

**Need a deeper analysis?** Contact us at contact@fractalpk.es.

**Want to share these results?** Cite as: *FractaLPK tumor_fitter (Fase A.1, simplified Hahnfeldt-Can), generated 2026-05-26 10:21 UTC, ID 1c9ae33732*.