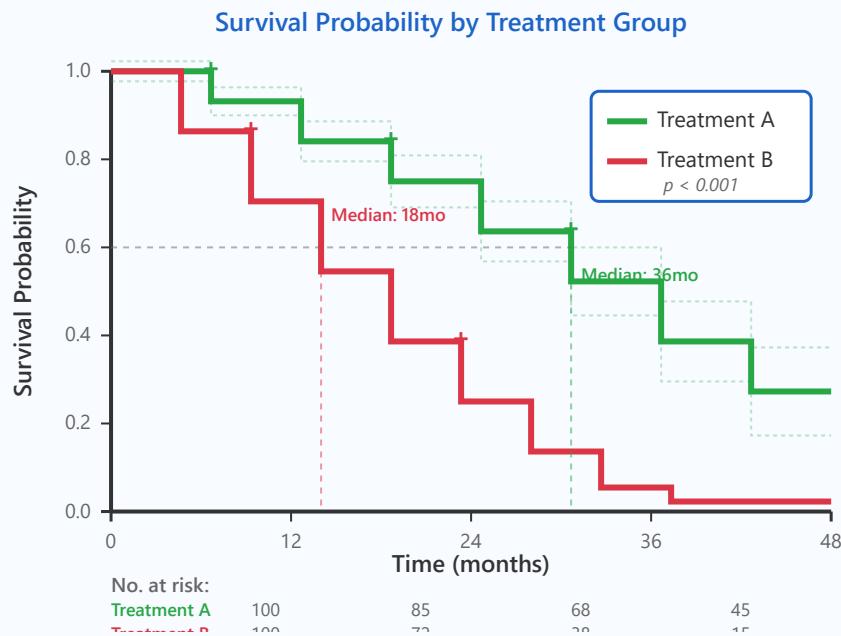


Kaplan-Meier Survival Curves

Non-parametric estimator of survival function

KM Curve Example



Key Components

- Step function visualization
- Confidence intervals (95% CI)
- Number at risk table
- Censoring markers (+)
- Median survival time

Log-rank Test

- Compare survival curves
- Null: no difference in survival
- P-value < 0.05 = significant
- Non-parametric test
- Assumption: PH holds

Clinical Interpretation: Always report median survival, 95% CI, and number at risk at key timepoints

Kaplan-Meier Estimation Principle

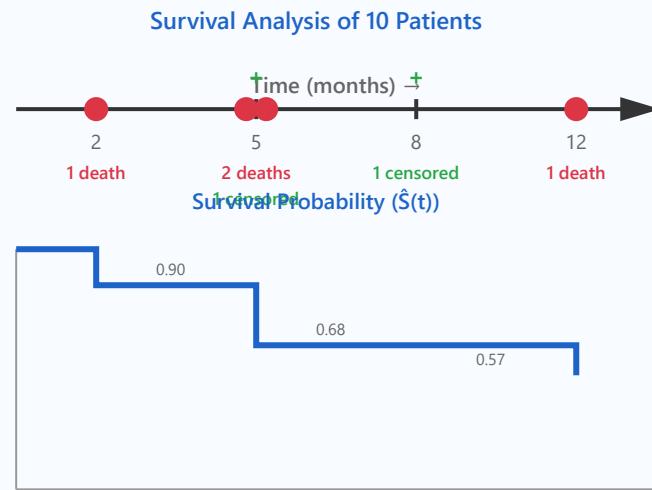
KM Estimation Formula

$$\hat{S}(t) = \prod_{t_i \leq t} (1 - d_i/n_i)$$

Variable Definitions:

- t_i : Time of event occurrence
 - d_i : Number of events at t_i
 - n_i : Number at risk just before t_i
 - $\hat{S}(t)$: Estimated survival probability at time t
- ▶ Calculate conditional survival probability at each event time
- ▶ Multiply all previous conditional probabilities (product-limit)
- ▶ Censored data only excluded from n_i , not counted as events

Calculation Example Visualization



Step-by-Step Calculation Process

Time (t_i)	At Risk (n_i)	Deaths (d_i)	Censored (c_i)	Conditional Survival ($1 - d_i/n_i$)	Cumulative Survival $\hat{S}(t_i)$
0	10	0	0	1.000	1.000
2 months	10	1	0	$9/10 = 0.900$	$1.000 \times 0.900 = 0.900$
5 months	9	2	1	$7/9 = 0.778$	$0.900 \times 0.778 = 0.700$
8 months	6	0	1	$6/6 = 1.000$	$0.700 \times 1.000 = 0.700$
12 months	5	1	0	$4/5 = 0.800$	$0.700 \times 0.800 = 0.560$

Key Points:

- ▶ Censored patients are excluded from the at-risk group after that time point, but not counted as events
- ▶ Calculate cumulative survival probability by multiplying conditional survival probabilities at each time point (Product-Limit Estimator)
- ▶ Survival probability does not change at time points without events (Step function)
- ▶ Survival probability beyond the last observation time cannot be estimated

Important: The KM curve is a non-parametric method that estimates the survival function without distribution assumptions and has the advantage of properly handling censored data.