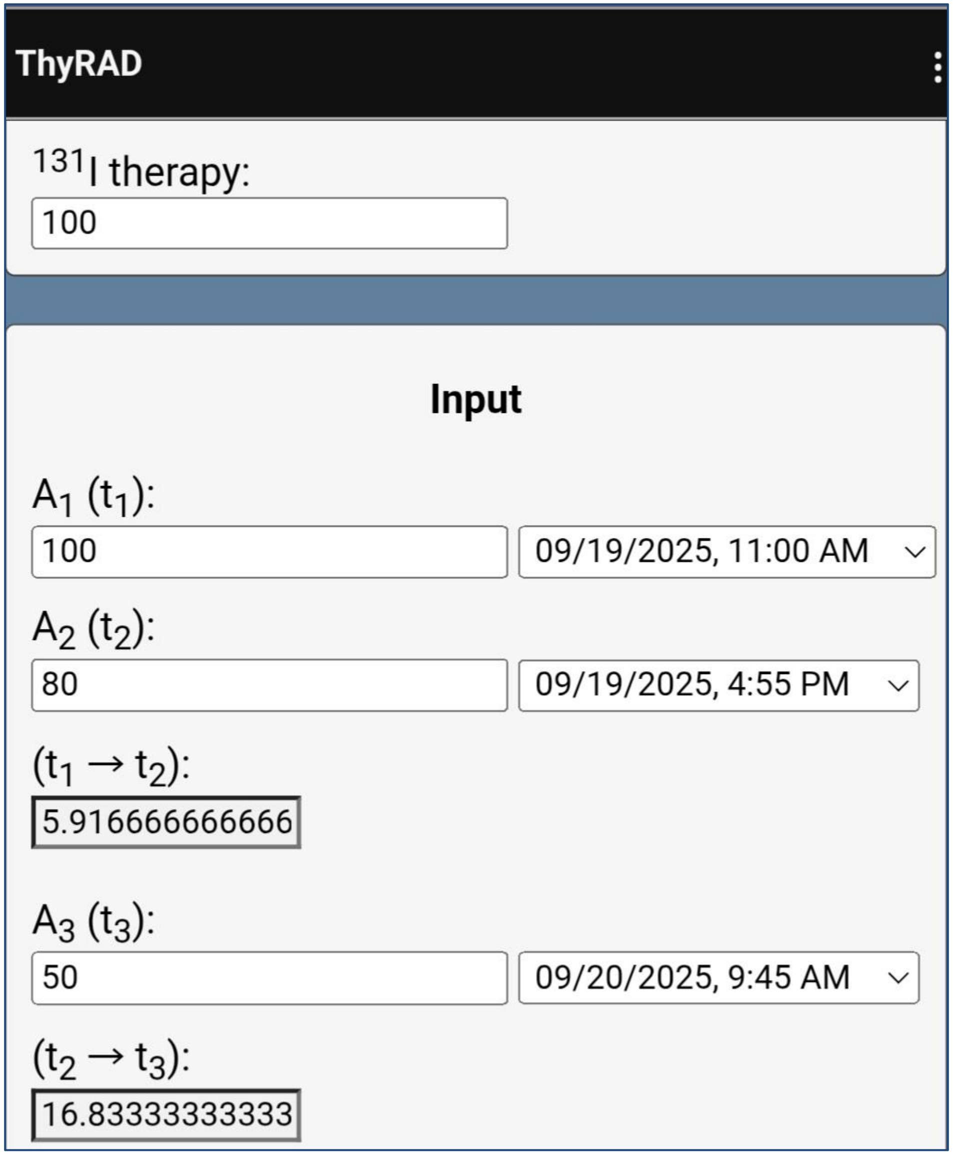
ThyRAD

Thyroid Radioactive Decay Prediction Tool

Quick Start User Guide



131I Therapy Reference value for the decay model. This value may correspond to the activity to be administered for patient therapy (e.g. 100 mCi).

In our validation study, measurements were performed on a phantom using a hand-held survey meter, aligned with the source at approximately 1 meter. This field is intended for modeling purposes only.

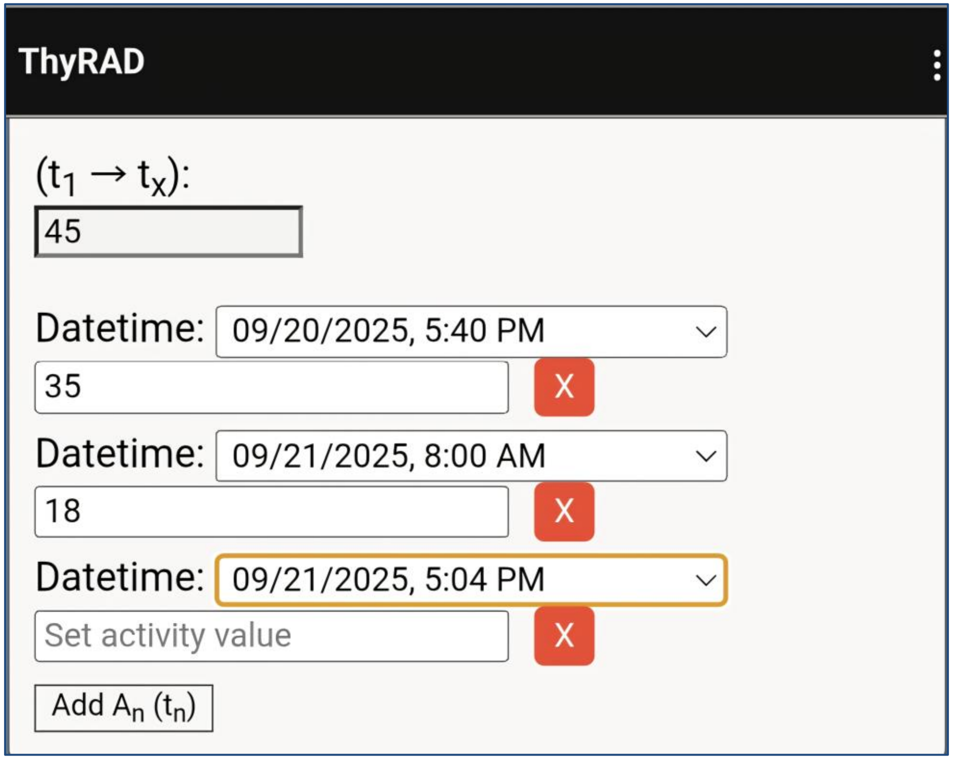
A_1 (t_1) — Set the recorded value observed at time t_1 (e.g. 100 µSv/h).

A_2 (t_2) — Set the second measurement recorded at time t_2 using the same geometry, distance, and instrument settings as $A_1(t_1)$, e.g. 80 µSv/h.

($t_1 \rightarrow t_2$) — The interval between the first and the second measurement, is automatically computed (e.g. 5.91 hours).

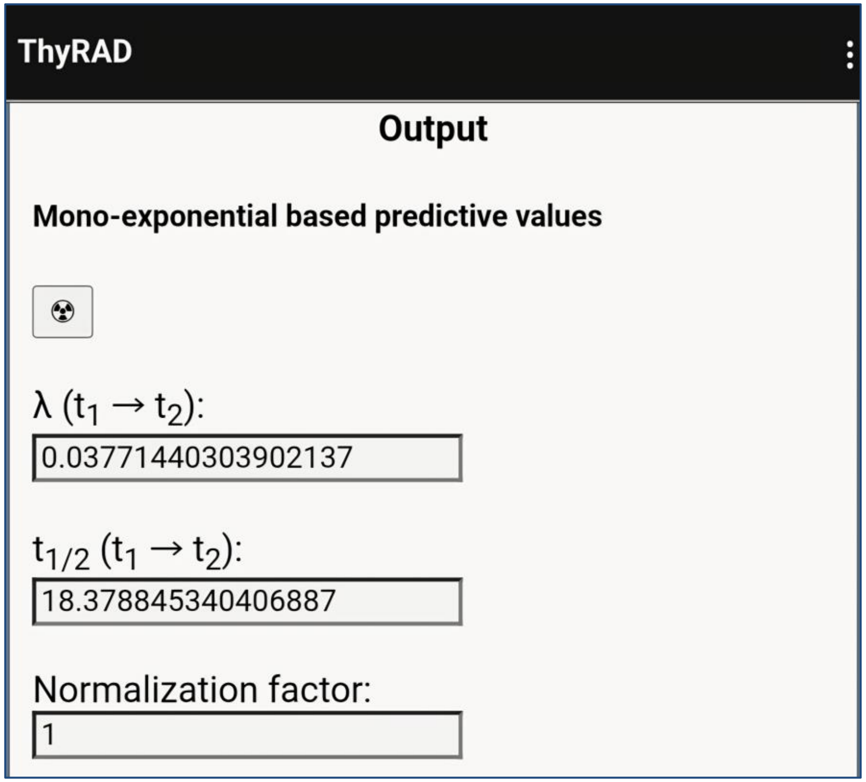
A_3 (t_3) — Set the third measurement recorded at time t_3 using the same geometry, distance, and instrument settings as $A_2(t_2)$ and $A_1(t_1)$, e.g. 50 µSv/h.

($t_2 \rightarrow t_3$) — The interval between the second and the third measurement, is automatically computed (e.g. 50 hours).



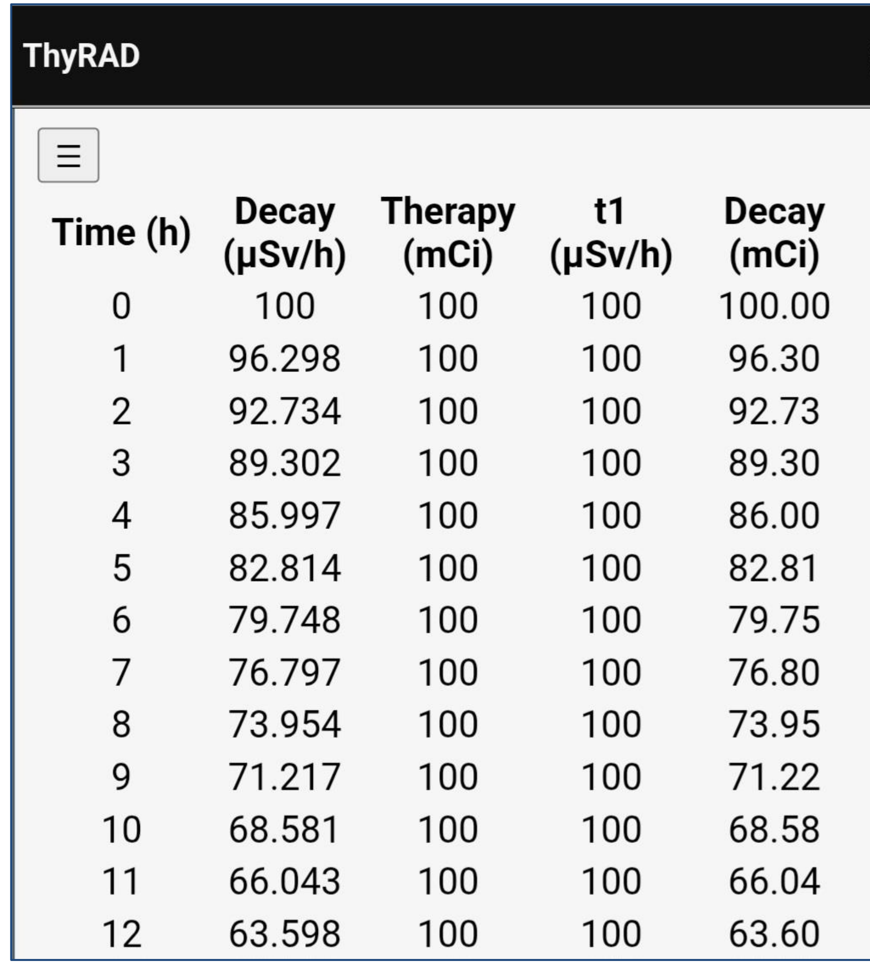
$(t_1 \rightarrow t_x)$: — The interval between the first and the last measurement, is automatically computed (e.g. 45 hours between the first and the last measurement).

Add $A_n(t_n)$ — Subsequent measurements recorded at time t_n (after the third). It's possible to add as many measurements as needed and each additional value (recording using the same geometry, distance, and instrument settings as the previous ones) will be included in the multi-segmented evaluation
(e.g.: the next fourth and fifth measurements were performed at 5:40 PM on September 20, 2025 (35 µSv/h) and at 8:00 AM on September 21, 2025 (18 µSv/h).



λ ($t_1 \rightarrow t_2$) and t½ ($t_1 \rightarrow t_2$) — Automatically computed from $A_1(t_1)$ and $A_2(t_2)$ using the mono-exponential fit: $\lambda = \ln(A_1/A_2) / (t_2 - t_1)$; t½ (hours) = $\ln(2) / \lambda$. The app reads the exact timestamps and uses the measurement units you entered. Results appear in this output panel; editing either measurement or its time updates the values automatically.

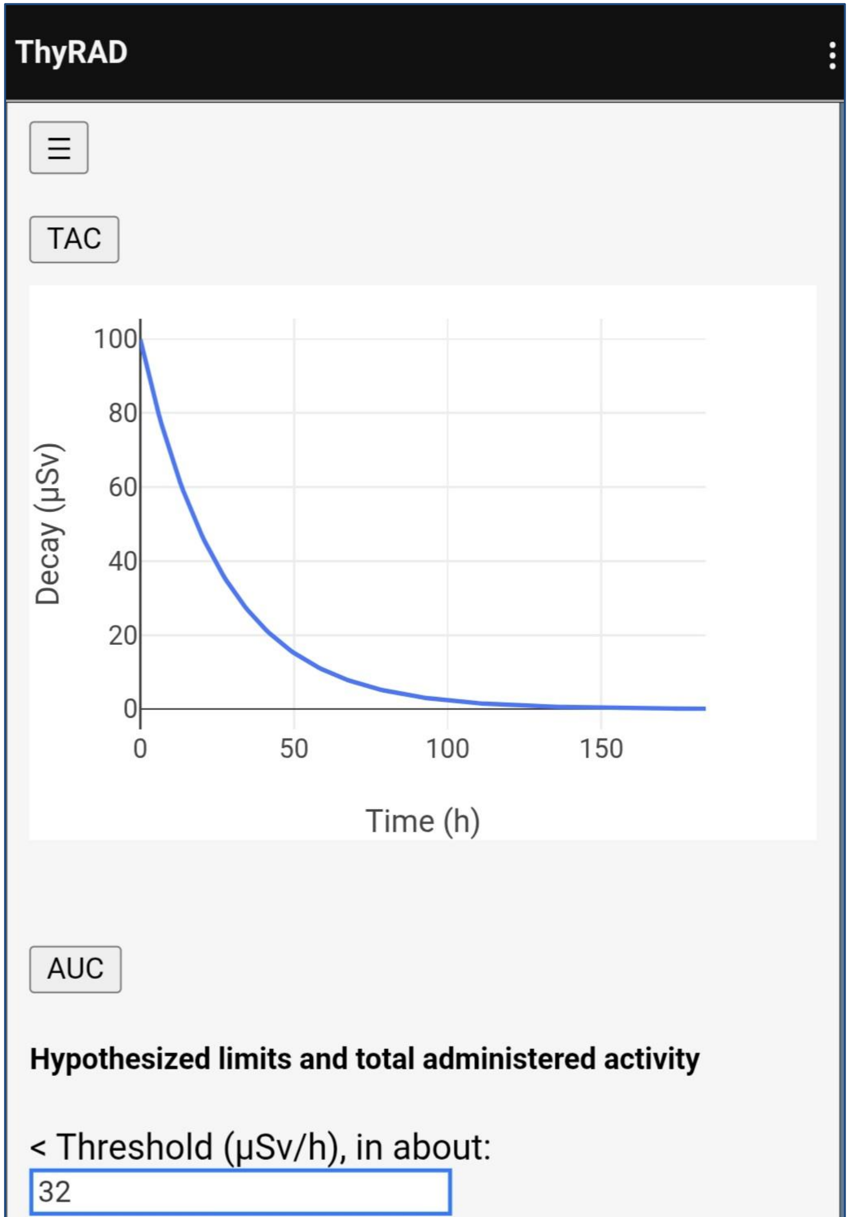
Normalization factor — Unitless multiplier applied to the half-life estimated over ($t_1 \rightarrow t_2$). The default is 1 (same slope after t_2). Values >1 slow down the decay; values <1 speed it up. Updating this field refreshes the Output and the predicted decay table/curve . This factor can be adjusted manually to explore research scenarios.



ThyRAD

Time (h)	Decay (µSv/h)	Therapy (mCi)	t1 (µSv/h)	Decay (mCi)
0	100	100	100	100.00
1	96.298	100	100	96.30
2	92.734	100	100	92.73
3	89.302	100	100	89.30
4	85.997	100	100	86.00
5	82.814	100	100	82.81
6	79.748	100	100	79.75
7	76.797	100	100	76.80
8	73.954	100	100	73.95
9	71.217	100	100	71.22
10	68.581	100	100	68.58
11	66.043	100	100	66.04
12	63.598	100	100	63.60

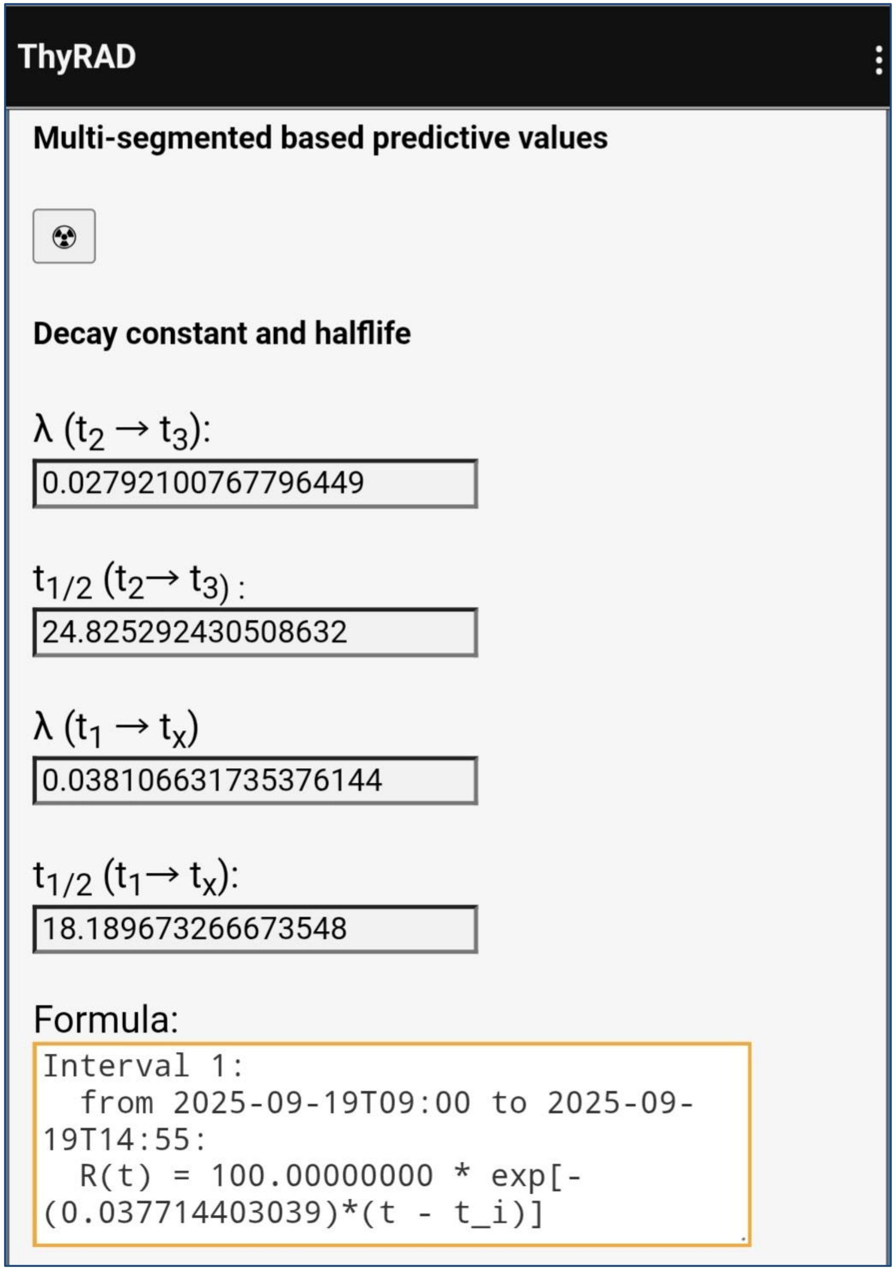
Decay Table ($t_1 \rightarrow t_x$) — Auto-populated hour by hour. Each row contains: Time (hours since t_1), Decay (expressed as µSv/h) predicted at the corresponding hour), Therapy (expressed in mCi), t_1 reference activity (expressed as µSv/h), and Decay (expressed in mCi) which is the retained activity at each time point computed by multiplying the predicted Decay (µSv/h) by the selected Therapy (mCi) and dividing by the initial rate t_1 (µSv/h).



TAC (Time Activity Curve) — The time axis is in hours since t_1; the vertical axis is the predicted rate (µSv/h) at the reference geometry.
Updating inputs refresh the curve and its values up to t_x.

AUC (Area Under Curve) — The time axis is in hours since t_1; the vertical axis is the predicted rate (µSv/h) at the reference geometry.
Updating inputs refresh the curve and its values up to t_x.

< Threshold (µSv/h), in about: — Estimated time for the predicted rate to fall below the selected threshold. By default, the threshold is set to limit of 30 µSv/h. The value updates automatically when inputs or the normalization factor change and can be verified on the decay table.
In this example, the 30 µSv/h threshold is reached in about 32 hours from the first measurement $A_1(t_1)$.



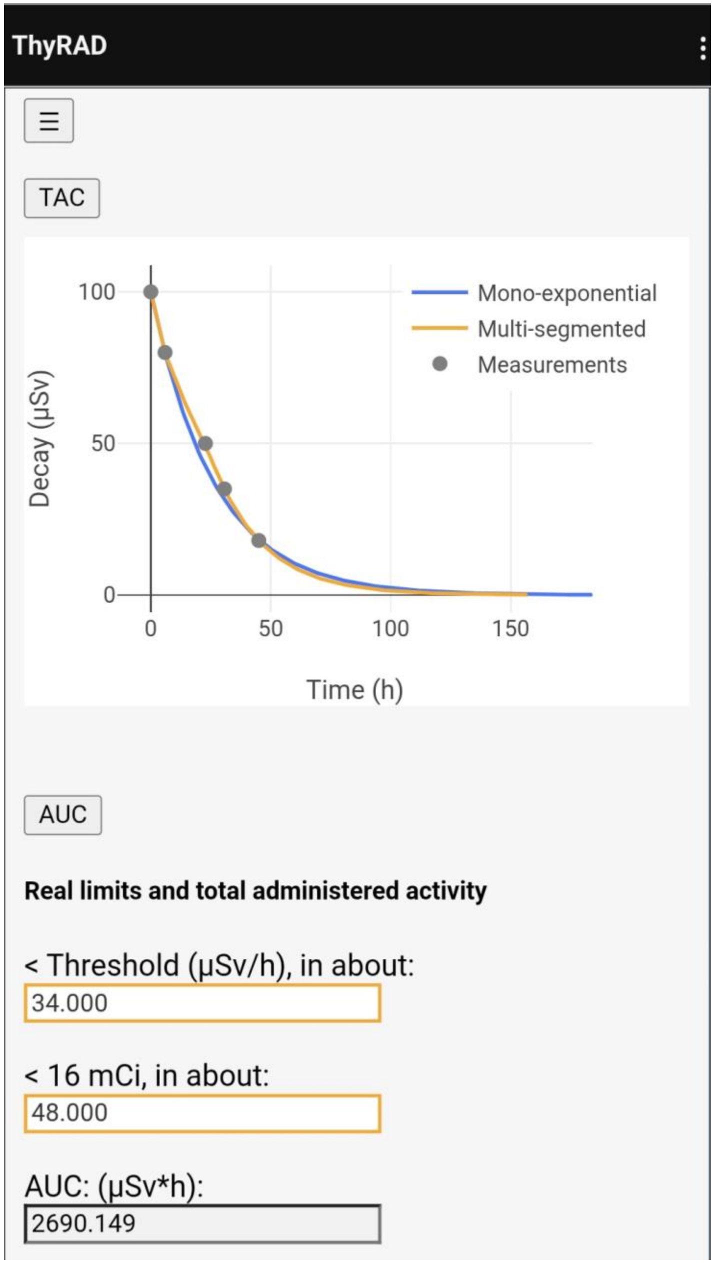
$\lambda\ (t_2 \rightarrow t_3)$ — Automatically computed from $A_2(t_2)$ and $A_3(t_3)$, if the third measurement is available; updates when either value or timestamp changes.

$t½\ (t_2 \rightarrow t_3)$ — Half-life derived from $\lambda(t_2 \rightarrow t_3)$ as $t½ = \ln(2)/\lambda$; reported in hours.

$\lambda\ (t_1 \rightarrow t_x)$ — Effective decay constant used for the overall model up to t_x; for the post-t_2 segment it is obtained from the current $t½(t_2 \rightarrow t_x)$ via $\lambda = \ln(2)/t½$.

$t½\ (t_1 \rightarrow t_x)$ — Effective half-life for the overall time span up to t_x.

FORMULA: — Multi-segmented based predictive values
Shows the analytic expression of the piecewise (multi-segment) decay curve built from your measurements. When ≥3 points are available, the tool estimates one decay rate for each interval between consecutive times and defines a continuous function segment by segment: on $[t_i, t_{i+1})$ the model follows a mono-exponential with the rate derived from $A_i(t_i)$ and $A_{i+1}(t_{i+1})$. The panel lists these interval-specific formulas and their time ranges, so you can see exactly which law is applied where; it updates automatically as you add or edit measurements

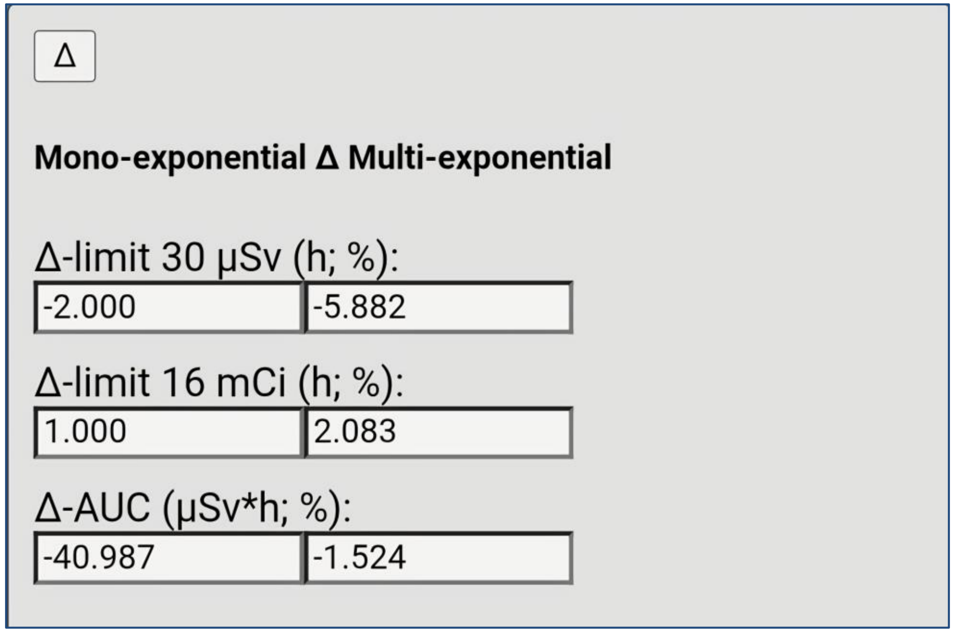


TAC (Time-Activity Curve)
— Displays both curves: the mono-exponential fit (from A_1– A_2) and the data-driven multi-segment model (≥ 3 points) overlaid with the measured points.
Time is in hours since t_1; vertical axis is the predicted rate (µSv/h) at the reference geometry. Updating inputs refreshes both curves up to t_x.

< Threshold (µSv/h), in about:
— Estimated time for the multi-segment curve to drop below the selected threshold (default 30 µSv/h). The value updates automatically and can be cross-checked on the decay table.

< 16 mCi, in about:
— Estimated time for retained activity to fall below 16 mCi based on the multi-segment model (may differ from the mono-exponential estimate). Updates when inputs change.

AUC (Area Under Curve)
— Integral of the displayed curve (µSv·h) over the shown time window. Reported for the multi-segment model and useful to compare against the mono-exponential trend; it updates when inputs change.



Δ limit 30 µSv/h (h; %): — Difference between the multi-segment and the mono-exponential time-to-threshold (30 µSv/h). Reported as hours and as percent relative to the mono-exponential estimate (positive = multi-segment later; negative = earlier).

Δ limit 16 mCi (h; %): — Difference between the multi-segment and the mono-exponential time to drop below 16 mCi. Reported in hours and as percent relative to the mono-exponential estimate.

Δ AUC (µSv·h; %): — Difference between the multi-segment and the mono-exponential Area Under Curve over the shown window. Reported as absolute AUC and as percent relative to the mono-exponential AUC (positive = multi-segment higher; negative = lower).

Computation Reference — Formulas

- $\lambda = \frac{ln(A_1/A_2)}{t_2 - t_1}$
- $\lambda_i = \frac{ln(A_i/A_{i+1})}{(t_{i+1} - t_i)}$
- $\lambda_n = \frac{ln(A_{n-1}/A_n)}{(t_n - t_{n-i})}$
- $A(t) = A_0 \cdot e^{-\lambda t}$
- $A(t) = A_2 \cdot e^{-\lambda(t-t_2)}$
- $A(t) = A_i \cdot e^{-\lambda_i \cdot (t-t_i)}$
- $A(t) = A_n \cdot e^{-\lambda_n \cdot (t-t_n)}$
- $A_{cum,i} = \int_{t_i}^{t_{i+1}} A(t)dt \approx \frac{Ai + A_{i+1}}{2} \cdot (t_{i+1} - t_i)$
- $A_{cum} = \sum_{i=1}^{n-1} \frac{A_i + A_{i+1}}{2} \cdot (t_{i+1} - t_i)$