

Biodosimetry Based on Acute Photon-Equivalent Exposure¹

Dose Estimate	Victims with vomiting	Time to Onset of Vomiting	Absolute Lymphocyte Count ²						Rate Constant for Lymphocyte Depletion ³	Dicentrics in Human Peripheral Blood Lymphocytes ⁴	
			Day 0.5	Day 1	Day 2	Day 4	Day 6	Day 8		Per 50 Cells	Per 1000 Cells
Gy	%	h	-----x10 ⁹ cells/L-----						k	n	
0	-	-	2.45	2.45	2.45	2.45	2.45	2.45	-	0.05-0.1	1-2
1	19		2.30	2.16	1.90	1.48	1.15	0.89	0.126	4	88
2	35	4.63	2.16	1.90	1.48	0.89	0.54	0.33	0.252	12	234
3	54	2.62	2.03	1.68	1.15	0.54	0.25	0.12	0.378	22	439
4	72	1.74	1.90	1.48	0.89	0.33	0.12	0.044	0.504	35	703
5	86	1.27	1.79	1.31	0.69	0.20	0.06	0.020	0.63	51	1024
6	94	0.99	1.68	1.15	0.54	0.12	0.03	0.006	0.756		
7	98	0.79	1.58	1.01	0.42	0.072	0.012	0.002	0.881		
8	99	0.66	1.48	0.89	0.33	0.044	0.006	<0.001	1.01		
9	100	0.56	1.39	0.79	0.25	0.030	0.003	<0.001	1.13		
10	100	0.48	1.31	0.70	0.20	0.020	0.001	<0.001	1.26		

1. Depicted above are the 3 most useful elements of biodosimetry. Dose range is based on acute photon-equivalent exposures. The second column indicates the percentage of people who vomit, based on dose received and time to onset. The middle section depicts the time frame for development of lymphopenia. Blood lymphocyte counts are determined twice to predict a rate constant that is used to estimate exposure dose. The final column represents the current gold standard, which requires several days before results are known. Colony-stimulating factor therapy should be initiated when onset of vomiting or lymphocyte depletion suggests an exposure dose for which treatment is recommended. Therapy may be discontinued if results from chromosome dicentrics analysis indicate a lower estimate of whole-body dose.
2. Normal range, 1.4 – 3.5 X 10⁹ cells/L. Numbers in boldface fall within this range.
3. The lymphocyte depletion rate is based on the model $L_t = 2.45 \times 10^9 \text{ cells/L} \times e^{-k(D)t}$, where L_t equals the lymphocyte count (X 10⁹ cells/L), 2.45 X 10⁹ cells/L equals a constant representing the consensus mean lymphocyte count in the general population, k equals the lymphocyte depletion rate constant for a specific acute photon dose, and t equals the time after exposure (days)
4. Number of dicentric chromosomes in human peripheral blood lymphocytes.

Adapted from: Waselenko JK, MacVittie TJ, Blakely WF, Pesik N, Wiley AL, Dickerson WE, Tsu H, Confer DL, Coleman CN, Seed T, Lowry P, Armitage JO, Dainiak N; Strategic National Stockpile Radiation Working Group. Medical management of the acute radiation syndrome: recommendations of the Strategic National Stockpile Radiation Working Group. *Annals of Internal Medicine* 2004; Vol. 140:1037-51.