Dose Limit Cheat-Sheet

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Introduction

The purpose of this document is to summarize dose limits of major interest in radiation protection, radiation imaging, nuclear medicine, and radiation imaging. The document is a work in progress and is intended to assist in clinical decision making and policy development by a radiation safety officer or medical physicist. All values in this list are derived from relevant published research, regulations, or standards that are widely accepted. These limits should only be used by personnel with an appropriate understanding of their meaning and limitations. Citations are included for all values for ease of reference. Please contact the author at esruiz@gatech.edu. with any suggestions or if any errors are found. This document is being developed with the intention to condense the contents into a ″cheat-sheet″.

Deterministic Effects

Deterministic effects will occur consistently above a given threshold. Below is a table of common deterministic effects. Deterministic thresholds are given in units of Gray (Gy), which is the SI unit of absorped dose, or Sieverts (Sv), which is the SI unit of effective dose.

Tissue Responses

Effect	Value	Source
Skin - Epilation	3 Gy	[1]
Skin - Erythema	6 Gy	[1]
Skin - Dry Desquamation	12 Gy	[1]
Skin - Moist Desquamation	25 Gy	[1]
Eyes - Cataracts	5 Gy	[1]
Skin - Radionecrosis	50 Gy	[1]
Public Annual Limit*	50 mSv	[1]
Rad Worker Annual Eye	150 mSv	[1]
Rad Worker Annual Skin	500 mSv	[1]

*NCRP 116 Effective Dose to lens, skin, and extremities.

Whole Body Exposures

Effect	Value	Source
Whole Body - Death	3-5 Gy	[1]
Hematopoeitic Syndroms	1-6 Gy	[1]
Gastrointestinal Syndrome	6-30 Gy	[1]
Neurovascular Syndrome	>30 Gy	[1]
$LD_{50/60}$ w/o intervention	4.5 Gy	[2]

Stochastic Effects

According to the Linear no-threshold model, stochastic effects occur with a probability which is proportional to the Total Effective Dose received. Below is a table of recomended limits from the National Council on Radiation Protection Report 116.

NCRP 116 Limits

Limit	Value	Source
Public Annual - continuous	1 mSv	[1]
Public Annual - infrequent	5 mSv	[1]
Monthly Dose to Fetus	5 mSv*	[1]
Rad Worker Annual**	50 mSv	[1]

*Once pregnancy is known.
**Lifetime Rad Worker Dose is 10mSv * age [years].

NCRP 116 Risk Estimates

Effect	Value	Source
Fatal Cancer - Workers	4%/Sv	[1]
Non-fatal Cancer - Workers	0.8%/Sv	[1]
Severe Genetic - Workers	0.8%/Sv	[1]
Fatal Cancer - Public	5%/Sv	[1]
Non-fatal Cancer - Public	1%/Sv	[1]
Severe Genetic - Public	1.3%/Sv	[1]
Emrbyo / Fetus (all effects)	10%/Sv	[1]

This is an example of an equation, where

$$H_E = D * w_R$$

Where w_R is the radiation weighting factor. Below is a table of the radiation factors.

NRC Regulations

Regulatory limits exist for deterministic and Stochastic responses. These limits sometimes differ from researched values.

NRC

Limit	Value	Source
Public Annual Limit	1 mSv	[3]
Annual Rad Worker (Adults)	50 mSv	[1]
Annual Rad Worker (Minors)	5 mSv)	[1]
Annual Lens	15 mSv	[1]
Annual Skin	50 mSv	[1]
Indiv. Organ (not lens)	50 mSv	[1]

Weighting Factors

Tissue Weighting Factors

Sources

[1] omp.org

[2] https://remm.hhs.gov/LD50-60.htm

[3] https://www.energy.gov/sites/prod/files/2018/01/f46/do
ionizing-radiation-dose-ranges-jan-2018.pdf