



The Case Against LNT

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LNT Based on 4 False Assumptions

(I) No such thing as repair of radiation damage

- Over 150 genes involved in DNA repair
- Cells adapt in response to stimuli
 - Antioxidant production
 - apoptosis
 - immune system effects
 - DNA repair within hours
- Nobel Prize in chemistry awarded to scientists who demonstrated repair of DNA lesions

LNT Based on 4 False Assumptions

(2) Dose rate doesn't matter

- Radiation delivered slowly much less damaging than the same dose all at once
- Rad Oncology – fractionate doses allowing for repair of surrounding healthy tissue

LNT Based on 4 False Assumptions

(3) 1 interaction → 1 DNA mutation → fatal cancer

- Stem cells giving rise to cancer contain thousands of mutations
- Nobel laureate Michael Bishop (discoverer of oncogenes): “A single mutation is not enough to cause cancer. In a lifetime, every gene is likely to undergo 10E10 mutations on separate occasions.”

(4) No processes exist at low doses that do not exist at high doses

- Repair enzymes present at low doses often inhibited from being synthesized at high doses

Math According to the LNT

- Collective dose concept – the population dose determines the number of cancers, regardless of the dose per person
- $1\text{E-}03/\text{rem} \times \text{person-rem} = \# \text{ cancer cases}$
- Statistics without biology
- This is how we “know” the number of cancer deaths caused by
 - Residential radon
 - CT scans

LNT – No Basis In Biology

- **Why would we extrapolate low dose effects from high dose effects? Why is radiation any different?**

These types of extrapolations don't make sense.

To determine the effect of	Extrapolate from the effect of
1 sleeping pill	Taking 100 sleeping pills
1 cm of rain in a day	100 cm of rain in a day
Applying warm water bottle to an aching joint	Applying boiling water to an aching joint
Applying cold pack to injured area to reduce pain	Applying liquid nitrogen to injured area
Hugging a baby	A bear hugging the baby
A gentle massage	Being pushed by an elephant
Drinking a cup of water	Drinking buckets of water
Jumping from a step	Jumping from top of building

Radiation Hormesis

- Low doses stimulate repair enzymes
- Enzymes repair not just radiation-induced damage
- Observed in microorganisms, algae, plants, insects, invertebrates, vertebrates, humans
 - Kojima (1999) – LDR increases antioxidants in brain (mice study)
 - Growth inhibition in bacteria in near 0 radiation (0.2 mrem/y) (WIPP studies; Smith et al. 2011, Castillo et al. 2015)
- Low dose radiation induced cancer or Low dose radiation induced hormesis?
 - Only one has been demonstrated scientifically
 - Hint-It's not LDR induced cancer

Is Hormesis Crazy...or Fairly Common?

- Sunlight
- Water
- Oxygen
- Wine
- Vitamins
- Fear
- Radiation?

And fortunately, you need not embrace hormesis to recognize the problems caused by LNT-based policies

NCRP Commentary No. 27

- NCRP (2018) Implications of Recent Epidemiologic Studies for the Linear Nonthreshold Model and Radiation Protection, Commentary No. 27
- Recommended continued support for use of the LNT
- Evaluated 19 studies (15 did not evaluate data for a threshold; that's 79% if keeping score!)
- Numerous papers critical of Commentary 27 have elicited no response...ignoring criticism does not make it irrelevant

Why Do People (Including Some HPs) Accept LNT?

- It's what we learned in school?
- Ignorance of the literature?
- Laziness?
- Fear of change?
- Fear of challenging the status quo?
- Conflict of interest (personal income could be at stake)?

President John Kennedy said:



For the **great enemy of the truth** is very often not the lie—deliberate, contrived, and dishonest—but the myth—persistent, persuasive, and unrealistic. Too often we hold fast to the clichés of our forebears. We subject all facts to a prefabricated set of interpretations. We enjoy the comfort of opinion without the discomfort of thought.

Let's Embrace The Discomfort of Thought

- LNT leads to billions of dollars wasted
 - Rad waste disposal (by not allowing low levels into commercial landfills) – as much as \$100,000 per reactor per year (comes to \$10 million per year to the nuclear power industry)
 - Reactor decommissioning – more than 1/3 cost goes towards llrw disposal...billions of \$
 - Environmental cleanup costs – CERCLA sites to 12 mrem/y (EPA's blind adherence to LNT)
 - Response and recovery costs following Fukushima type incident?

How to begin to change public policy?

1. Educate the public and the media; don't be afraid to say 'LOW DOSES ARE SAFE' – your head will NOT explode...really, it won't!
2. We should encourage regulators to end ALARA/LNT – based policy
3. Support more **research on low doses**, which is not the same as more **research on the risk of low doses** (see NAS 2022)

The linear no-threshold model of radiogenic cancer is false. Because it fails empirically against superior empiricism, it becomes misinformation and opinion, not knowledge, but it is still advocated because it lends contentment to believers. We can no longer tolerate the universal application of LNT misinformation when, as people of science, we are about helping, not harming, humanity.

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