

Leukemia incidence of 96,000 Hiroshima atomic bomb survivors is compelling evidence that the LNT model is wrong

Edward Calabrese's papers "Origin of the linear no threshold (LNT) dose-response concept" (Arch Toxicol (2013) 87:1621–1633) and "How the US National Academy of Sciences misled the world community on cancer risk assessment: new findings challenge historical foundations of the linear dose response" (Arch Toxicol (2013) 87:2063–2081)

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Radiobiology and toxicology owe a great debt of gratitude to renowned toxicologist Professor Edward Calabrese for his very careful investigation into the origin of the linear-no-threshold (LNT) model for cancer risk assessment (Calabrese 2013a) and for identifying the role of the US National Academy of Sciences in recommending world adoption of this unscientific concept (Calabrese 2013b). This letter is to express my appreciation to the Archives of Toxicology for publishing these very important revelations.

The linking of low radiation to a risk of cancer in the 1950s was based on the idea that radiation produces genetic damage and that some of these mutated cells *progress* into cancer cells. For more than 50 years, this concept has created enormous fear, uncertainty, and doubt about the safety of exposures to small doses of radiation and chemicals, even though positive health effects had been identified by medical scientists and practitioners soon after X-rays and radioactivity were discovered. High, short-term exposures were harmful, but low acute doses or low dose-rate chronic exposures were beneficial. Many review papers detailed accepted medical applications, such as the healing of wounds and infections, cancer cures, and treatments for inflammations and arthritis, before the introduction of the cancer scare in the late 1950s (Cuttler 2013).

For more than 20 years, scientists have known that the spontaneous rate of DNA damage far exceeds the DNA damage rate induced by background ionizing radiation (Billen 1990). Recent evidence indicates that the endogenous rate of single-strand breaks (SSBs) is more than a million times the rate induced by average background radiation.

The natural rate of double-strand breaks (DSBs), which is the concern regarding cancer risk, is a thousand times greater than the rate of DSBs by background radiation (Feinendegen et al. 2013). Therefore, low radiation levels are not a significant cause of DNA damage and cancer.

How then does ionizing radiation produce health effects? Feinendegen et al. (2013) point out that all organisms possess very powerful adaptive protection systems that repair or remove cell, tissue and organ damage, and restore organism health. Radiation is one of the stressors that modulate the protection systems; high radiation impairs protection, while low radiation up-regulates many protection systems (>200 genes) that act to produce very important positive health effects, including a *lower* incidence of cancer. This is the mechanism for the significant net beneficial effects of low doses even below ~200 mSv or 20 rem. At higher doses, additional protective mechanisms against cancer development operate.

The leukemia incidence of 96,000 Hiroshima atomic bomb survivors is compelling evidence that the LNT model is wrong. Figure 1 (Cuttler 2014) shows that these data fit a hormetic *J*-curve; they do not fit a straight line. The data (UNSCEAR 1958, Table VII, p.165) clearly demonstrate that a threshold for leukemia occurs at about 500 mSv or 50 rem.

The continued application of the invalid linear dose-response model for cancer risk assessment raises enormous fear about the safety of exposures to small doses of radiation (and chemicals). Linking low radiation to a "risk of health effects" and the emergency measures to mitigate exposure to low radiation levels has caused and continues to cause many premature deaths and enormous psychological suffering of large populations who received small radiation exposures. Ongoing use of this unscientific methodology is blocking nuclear energy projects and severely

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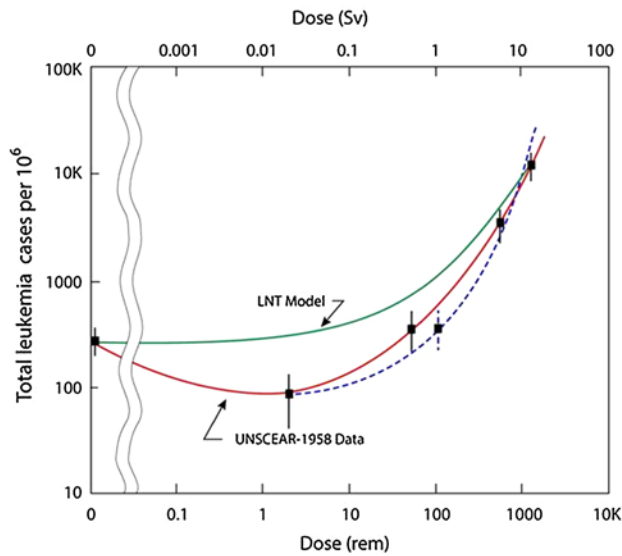


Fig. 1 Leukemia incidence in the Hiroshima survivors, 1950–1957 (Cutler 2014). *Dashed blue line* through 100 rem dose addresses footnote for 50 rem dose in UNSCEAR 1958 “that almost all cases of leukemia in this zone occurred in patients who had severe radiation complaints, indicating that their doses were greater than 50 rem”

constraining vital applications of X-rays and radioisotopes in medicine.

It is time for the scientific community to urge the US National Academy of Science to recognize its error and abandon the politicized science it fostered in 1956.

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